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Some Problems in the Theory of Diffraction and Refraction in Stratified Media

by Gottfried Eckart and Hubert Martin

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Some Problems in the Theory of Diffraction and Refraction in Stratified Media

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Abstract

The purpose of the present paper consists of treating some problems arising in the theory of wave propagation in stratified media. The stratification is supposed as being continuous im some partial questions or discontinuous in another ones.

The problems in question are diffraction problems in a strong relation to refraction; generally such problems are very difficult: therefore some authors have given approximative solutions based on physical reflections for conditions of great generality; such a solution has often an asymptotic caracter: it becomes rigorous by an infinite approximation to some limite in the given conditions, i.e. for instance the dielectric constant $\mathcal{E}$ as a function of the coordinates. The errors of an approximative theory are not known in general. Therefore we have an interest on a comparision of the approximative solution with a rigorous one in a case where such a rigorous solution is known and of sufficient generality. The most important approximative theory for the propagation of waves is due to Seckler and Keller [23]. It is based on the supposition that in a stratified medium the power within a tube of rays is constant, it calculates rays thereafter the cross-section of tubes of rays as tubes of constant power, from what follows the field intensity. This calculus neglects the continuously distributed inner reflection of waves. On the other hand one of us (E) has given a rigorous solution [18] [19] of the problem of waves in medium of plane stratification in the form of an Epstein-layer.. (Fig. 1). The difference of $\mathcal{E}$ values below and above a layer of given thickness can be varied and the thickness of the layer also. This solution furnishes a sufficient

generality. The authors are indebted to Professor Felsen (Microwave Research Dpt. Polytechnic Institute Brooklyn) for kindly having given the hint that some research workers in U.S.A. using Seckler's and Keller's approximations are interested on a numerical knowledge of the errors of this theory and so the authors furnish in the present report numerical evaluations of it in comparision with E's rigorous solution for the Epstein-layer. This is the first part of this paper. It turns out directly that the above mentioned reflection is the main error of Seckler's and Keller's theory and we have given many examples where this reflection is week and another ones where it is strong. The exact numerical knowledge of this continuous reflection is given in a broad domain of variation of the gradient of $\mathcal{E}$.

In the case, where rays are returning in a zone of total reflection, behind this zone real rays does not more exist in the original sens of their definition. In the original case rays and lines of Poynting vectors and normales to the surfaces of constant phase ("Wave normals") are identical. Behind the zone of total reflection arise transversally attenuated waves: the surfaces of constant phase and constant amplitude are perpendicular one to another: there exists a real and an imaginary component of Poyntings vector. Wave normals are identical with the direction of it's real part;thus the imaginary part is perpendicular to phase normals, is the direction of exponential attenuation. <u>Now the question arises:</u>

<u>Is it allowed to consider the lines of real part of Poyntings vector = phase normals as "rays" in the theory of diffraction.</u>

The existence of such waves in an homogenous medium behind a zone of total reflection is well known. Futhermore E has shown in [18] [9] that this type of wave exists also behind an Epstein layer, where the medium becomes approximatively homogenous. The answer of the above mentioned question has to proof:

Let an transversally attenuated wave be incident on a smooth obstacle in its field. The limit of the shady zone

is still furnished by the rays of our definition. This demonstration is given by an integral equation method due to Samans in 2.1.

This first step is to be continued. E. treats in some generality the diffraction problem of transversally attenuated waves by infinitely conducting cylinders and spheres.

In the scope of the present report this problem is studied by the following steps:

1) In the shady zone the "creeping" waves [4] or Watson waves [9] [19] [11] furnish the solution. We have to extend the theory of these waves to the case of incidence of transversally attenuated waves, to see their distortion in our case.

2) On particular in the case of the sphere it turns out that the classic series following Legendre functions does not more converge on the whole surface of the sphere. The present report shows that Watsons transformation gives automaticly an analytic continuation, the distortion of Watson waves is treated.

3) Franz [4] has shown that in the illuminated side of the sphere or the cylinder besides the incident wave the solution consists of two parts: the sum of the creeping waves coming from the shadow side of the obstacle and a part becoming the geometrical optics of the rays on the surface for $\omega \to \infty$. Therefore the geometrical optics of transversally attenuated waves is treated in the following form in greater genereality:

Let an transversally attenuated wave be incident on a plane surface of another dielectric or infinitely conducting medium: reflection-transmission coefficients are calculated. An analytic continuation of Snell's law to complex angles of incidence was to be effected. The direction of incidence is given by wave normals. It turns out, that the real angle of incidence is directly to be added to the complex one in the case where this angle is zero. The complex angle is the angle defined by classical

reflection theory.

Thus we see:

Taking wave normales as rays in the case of transversally attenuated waves we find a shadow-formation given by these rays and we are able to apply Watsons transformation also if the classical series are not convergent.

A short supplement treats the reaction of a third layer, behind a zone of total reflection to the total reflection. We know: If in the third sone a homogenous wave arises, total reflection is destroyed. However the author has never found in the litterature a treatise making evident the mechanism of this effect. It is often unpleasant for the reader to consult textbooks and papers. For this reason the author has given in seven appendices every material necessary for understanding the present report for a physicist of general formation not especially aquainted with propagation and diffraction theory.

Contents.

1) Numerical Evaluations of the Approximative Diffraction Theory of Seckler and Keller in Comparison with the Rigorous Solution in the Case of an Epstein Layer.

By G. Eckart and H. Martin

Seckler and Keller [23] have developed a theory of diffraction of electromagnetic waves in an inhomogenous medium, the basic idea of which is represented in Appendix VII.

One of us (E) has given a rigorous solution of the same problem in [18] [19] [20] in the case of an Epstein-layer. An outline is given in Appendix VI.

Prof. Felsen (Polytechnic Institute of Brooklyn) has kindly made the remark that it seems to be useful to know exact numerical values of S. and K's solution in comparison with rigorous ones in the above mentionded case. For this purpose Mr. Martin has executed numerical evaluations of both theories.

The main interest is concentrated on the knowledge of conditions, furnishing exact values of S. and K's theory on the one hand and on the other hand conditions where S. and K's theory becomes erroneous and the order of magnitude of these errors.

The computer of the Computer-Center of the University of Saarbrücken is of the type Zuse Z 22, not usual in U.S.A. Therefore the entire programm is not reproduced here.

It is evident (App.VII) that the main error of S. a. K. consists of the fact, that these authors neglect the multiple continuous reflection due to the continuous stratification of the dielectric constant of the medium.

The theory of the Epstein-Layer is surveyed in App. VI. At the first glance it seems to be probable that this reflection is direct proportional to the variation of on a wave length, but a deeper study shows, that this effect is more intricated. However the function

of the Epstein-layer (App. VI)(Fig.1) shows a linearly variating ε in a certain layer of the thickness $4/\kappa$ (App. VI); the transition to constant values of ε outside of this layer is effected with continuous derivatives of any order. The exponential caracter of ε

$$\varepsilon(z) = 1 + \frac{\delta}{1+e^{\kappa z}}$$ (See fig. 1 and App. VI)

produces a smooth transition to the limiting values of ε outside of the layer above mentioned.

In [18] one of us has given an exact solution of the differential equation of the rays. But for the use of the computer a direct numerical solution is prefered. The term "vectorlength" on the top of the numerical tables denotas the length of the steps used for the integration of the differential equation of the rays. The evaluations are effected for three frequencies:

$\omega = 3 \cdot 10^7$, $\omega = 3 \cdot 10^8$ and $\omega = 3 \cdot 10^9$

The values of ϑ_0 = angle of incidence with vertical axis in the chosen minimum of height (App. VII)

δ = Difference of the limiting values of for $z = \pm$

$\kappa = 4/d$, d = layer thickness (Fig.)

chosen for the evaluation are given in Table I.

It was chosen a minimal height below $z = 0$, the symmetry-level of the layer sufficently great, so that the medium there is alsready homogenuous in good approximation. On a page of these evaluations we find on the top

ω, κ, δ and vectorlength

for this condition and the value ϑ_0, the angle of incidence = angle of direction of the ray in the minimum of height the reflection coefficient is given: first number its absolut value, second number its phase in radiance ($3{,}1415 = \pi$). The transmission-coefficient is denoted as "Transitfactor" also in two numbers: value and phase.

The third line gives α, β, γ for the chosen layer. For the incident wave α, β, γ is given by eq.7 appendix VI., valuable for v_1, eq. (8) App. VI. Since the real part of these parameters is 1 the numbers in the top of the tables denotes only the imaginary part. For the distortion functions D_i, D_r, D_t Alpha, Beta, Gamma denote only the first, second, third parameter in the hypergeometric function. (15)(16) show, that only signs are commuted by forming the combinations of α, β, γ used for v_1, v_2, v_3. Gamma enters by its imaginary part (eq. (15)(16) App. VI) with different sign. In the top of the numerical tables we give only the abs. value of the im. part of α, β, γ. The third parameter in D_t (eq.(17 App. VI) is not indicated on the top. It does not contain δ. The colonnes of numbers below the top denote

1) Height in the ray
2) ϑ as a function of height
3) S. a. K's value
4) ζ, the Epstein parameters $= -e^{\kappa z}$
5) The number of terms used for calculating hyperg. functions with sufficient precision
6) Distortion function real part for the upgoing wave
7) " " im. part " " upgoing wave
8) " " real part " " downgoing wave
9) " " im. part " " downgoing wave

Above height = 0, we have only the upgoing transmitted wave, the latter two are not more existent.

Concerning 6)7): The distortion function for the upgoing wave is multiplied by unity, this one for reflected wave by R, and this one for the transmitted wave by T.

About "height $\sim$ 0" we have following App. VI. a continuous transition between the transmitted wave on the one hand ($z > 0$) and the sum of the incident and reflected wave ($z < 0$). However there exists often a strong variation of the field.

For the heighest frequency $\omega = 3 \cdot 10^9$ the parameters of the hyperg. functions take great values; forming higher

terms in the hypergeometric series we arrive at the limit of the range of our little computer. Some last terms on a colonne then are not more exact.

The reader is now able to compar S. a. K's solution with rigorous values, to find conditions concerning the gradient of $\mathcal{E}$, the frequency, the layer thickness of an inhomogenous medium, where the approximation used by S and K furnishes an error small enough.

The case of total reflection, returning rays was not taken into account in the numerical calculus. However the remaining chapters deal with the conditions beyond the level of total reflection in the domain of transversally attenuated waves. It is important to remark that for negative values of the height we have two colonnes in the distortion function: incident and reflected wave, for positive heights we have the transmitted wave only.

Kellers solution is always good where the reflected wave is weak and the value of the distortion function $\sim$ 1.

This is evident that the second part of the error of K's theory besides the reflected wave in the zones outside of the transition layer consists of the deviation of the distortion function from the value 1 deviation also due to multiple inner reflections.

The Epstein-Medium is almost homogenous outside of the transition layer. Reflection- and transmission coefficient (App. VI) are the coefficients of the entire layer concerning the corresponding waves in the almost homogenous medium (eq. 11-14 App. VI), being formally valuable also inside of the layer.
Suppl. remark: The absolute value of the exponential function is everywhere = 1, so that the value of the distortion function multiplied by 1, R, T for the incident, reflected transmitted wave resp. is the value of the rigorous solution.

2. Some Diffraction Problems in Stratified Media Especially in the Field of Transversally Attenuated Waves by G. Eckart

2.1 The Formation of Shadow in the Field of a Transversally Attenuated Wave (Infinitely Conducting Cylinder of Arbitrary Smooth Cross Section)

In this chapter we shall restrict ourselves to scalar waves. The attenuation is directed along the surfaces of a constant phase, perpendicular to the wave normal. The wave normal would be identical with the real part of Poyntings vector for electromagnetic vector waves. At first we make some remarks about the diffraction problem of a plane wave, incident on an infinite cylinder, with the boundary condition

(1) $u = 0$ on the surface

This is mathematically equivalent to the problem of a plane electromagnetic wave, the E vector of which is parallel to the axis of the cylinder, supposed to be infinitely conducting and its surface being without edges.

This treatise is related to Kellers theory of diffraction. It shows that wave normales can be used as analytic continuation of rays; we shall see that such a cylinder generates a shadow zone limited by "rays" realised by the wave normal.

We shall somewhat generalise a theory elaborated by Mr. Samans for homogenous waves.

The author is very indebted to Prof. Claus Müller, Aachen, for kindly leaving the paper of his pupil Mr. Samans, not yet being published.

We treat the formation of shadow by an asymptotic solution of Maues integral equation of first kind for $\omega \to \infty$ [2] [3] . As already mentioned we choose the case of an incident elastic wave with E parallel to the axis of the cylinder. This is exactly the problem of a scalar wave u

with the boundary condition (1) on the surface. The unknown function in Maues integral equation of first kind is $\partial u/\partial n$

In geometrical optics shadow formation is infinitely sharp in the limit $\omega \to \infty$. Thus we wish to give an asymptotic solution of Maues integral equation with regard to $\partial u/\partial n$; in the case of a transversally attenuated wave we have to take into account the following remarks:

The mathematical expression of the wave is

$$(2) \quad u_{inc} = \exp[jkx\cosh v - yk\sinh v]$$

in an xy system of coordinates. The transition to the limit $\omega \to \infty$ would give a wave completely distorted:

For an $|y|$ as small as on likes

$$(3) \quad y > 0 : \ u_{inc} = O(e^{-k|y|\sinh v}) \to 0$$

$$(4) \quad y < 0 \quad u_{inc} = O(e^{+k|y|\sinh v}) \to \infty$$

This transition to a limit seems to be not reasonable. For $k \to \infty$ we wish to variate v so that the attenuation on the length 1 in the y direction remains constant, i.e. we require

(5) $k\,\sinh v = p = \text{const}$ and we get:

(6) $u_{inc} = \exp[jkx\cosh v - py]$ consequently

$$(7) \quad \sinh v = \frac{p}{k}, \quad \cosh v = +\left|\sqrt{1 + p^2/k^2}\right| = 1 + O\left(\frac{p^2}{k^2}\right)$$

and the incident wave is:

(8) $u_{inc} = \exp\left[jkx\sqrt{1+\frac{p^2}{k^2}} - py\right]$

For making more comprehensive the following study for readers who have not Maues paper at their immediate disposal the author reports shortly some essential features [2] .

Let a smooth obstacle be placed in the field of an incident wave, at the surface of this body (P= point of observation, Q= point of source) we put the value for u

(9) $u(P) \overset{def}{=} f(P)$

The normale derivative may be

(10) $\frac{\partial u(P)}{\partial n} \overset{def}{=} g(P)$

Maue treats problems in three dimensions of space, his Greens functions is taken as.

(11) $G(P,Q) = e^{jkR}/4\pi R$

By this normalisation of Greens function the factor $\frac{1}{4\pi}$ is not more existent before the sign of integration in Greens formula. In the boundary value problem $u(P)=f=0$ $\partial u/\partial n = g(P)$ on the surface of the diffracting body can be found by solution of one of the following two integral equations:

(12) $u_{inc}(P) = \iint G(P,Q)\, g(Q)\, df_Q$ or

(13) $\frac{\partial u_{inc}(P)}{\partial n} = \frac{1}{2} g(P) + \iint \frac{\partial G(P,Q)}{\partial n_P} g(Q)\, df_Q$

df_Q - surface elem. of the body in Q

(12) represents an integral equation of first kind
(13) an equation of second kind [3] [4] . In the cyl. case

$u = 0$ corresponds to the boundary condition for the magnetic potential corresponding to the vector E supposed as parallel to the axis of the infinite cylinder. We follows Saman's two dimensional calculus; the incident wave in Saman's paper is supposed as a homogenous plane wave. This paper makes immedialtely evident the shadow zone. Our problem supposes an incident wave of the type given by equation (8).

Samans solves Maues integral equation of first kind in an asymptotic manner. His integral equation uses a normalisation so that

$$g_{Samans}^{(P)} = \frac{1}{2} g_{Maue}^{(P)} \tag{14}$$

In the plane of the cross section of the infinite smooth cylinder Samans uses as Greens function

$$\mathcal{G}(P, Q) = \mathcal{H}_0^{(1)}(k\,|\vec{\varrho}(t) - \vec{\varrho}(s)|) \tag{15}$$

$\vec{\varrho}(t)$ is the position-vector of Q (source point)
$\vec{\varrho}(s)$ is the position-vector of P (point of observation)
t is the parameter of the curve length at the border of the cross section of the cylinder whose axis is supposed perpendicular to the plane of design, s is the t-value for the point of observation.
We are generalising Samans caluculus upon an inhomogenous incident wave.
In what follows let denote

- $\vec{A}$ the unity vector in the direction of the phase (wave-) normal = real part of Poyntings vector
- $\vec{A'}$ the unity vector in the direction of attenuation, perpendicular to $\vec{A}$ (Fig.6)
- $\vec{n}$ = unity vector on the contour of the diffracting cylinder, supposed being smooth without edges
- C_1 is the illuminated part of the contour
- C_2 is the shady side (Fig. 6).

The incident wave is:

$$(16) \quad u_{inc} = \mathcal{F}(P) = \exp\left[jk(\vec{A}\cdot\vec{\varrho})\sqrt{1+p^2/k^2} - p\cdot(\vec{A}'\cdot\vec{\varrho})\right]$$

where

(17) $(\vec{A}\cdot\vec{\varrho})$ $\rightarrow$ is the scalar product of the two vectors $\vec{A}$ with $\vec{\varrho}$.

In the following text we shall often write

$$(18) \quad r = |\vec{\varrho}(t) - \vec{\varrho}(s)|$$

Then it arises the integral equation corresponding (12)

$$(19) \quad \underbrace{\mathcal{F}(\vec{\varrho}(s))}_{\text{Inc. wave}} = \frac{j}{2}\int_{C_1+C_2} g(t)\, H_0^{(1)}(k|\vec{\varrho}(t)-\vec{\varrho}(s)|)\, dt$$

to be resolved with respect to $g(t)$

The shadow problem related with consists of showing that for $k \rightarrow \infty$ the geometrical optics of the phase normal (real part of Poyntings vector) furnishes the solution, that is to say that for $k \rightarrow \infty$ $g(t)$ in C_2 disappears whereas in C_1 $\partial\mathcal{F}/\partial n$ is the solution. We shall demonstrate that for $k \rightarrow \infty$ the asymptotic solution is given by

$$(20) \quad \begin{aligned} g(t) &= \frac{\partial\mathcal{F}}{\partial n} \quad \text{upon } C_1 = \text{illuminated side} \\ g &= 0 \quad \text{upon } C_2 = \text{shady side} \end{aligned}$$

The solution is performed by means of saddle points method and Riemann-Lebesgues lemma [5] S. 172. For $k \rightarrow \infty$ the saddle point method becomes rigorous and we have to verify that (20) is the solution, $g = 0$ in the shady side is then the prouve for our affirmation, that "rays" are pepresented by wave normals.

We shall follow the calculus of Samans and we shall show that the case of the ihhomogenous wave differs from

Samans result only by the attenuating factor, arising as a "slowly variable" function in the saddle point-integrands; this is a very simple result, but also of some interest. Some necessary explanations are composed in the appendices III and IV.

At first we state $\partial \mathcal{F}/\partial n$ from (16)

$$\frac{\partial \mathcal{F}}{\partial n} = \exp\left[jk(\vec{A}\cdot\vec{e}(t))\sqrt{1+p^2/k^2} - p\cdot(\vec{A}'\cdot\vec{e})\right] \tag{21}$$
$$\times\left(jk\sqrt{1+p^2/k^2}\,(\vec{A}\cdot\vec{n}) + p\,(\vec{A}'\cdot\vec{n})\right)$$

An asymptotic representation of this is with

$$\sqrt{1+\frac{p^2}{k^2}} = 1+\frac{1}{2}\frac{p^2}{k^2} + O(p^4/k^4) \quad \text{and} \tag{22}$$

$$\frac{\partial \mathcal{F}}{\partial n} = \exp\left[jk(\vec{A}\cdot\vec{e}(t))\right]\exp\left[\tfrac{j}{2}\tfrac{p^2}{k}(\vec{A}\cdot\vec{e}(t))\right]\exp\left[-p(\vec{A}'\cdot\vec{e}(t))\right] \tag{23}$$
$$\times\left(jk(\vec{A}\cdot\vec{n})\left(1+\frac{p^2}{k^2}+O\left(\frac{p^4}{k^4}\right)\right) - j(\vec{A}'\cdot\vec{n})\left(1+O\left(\frac{p}{k^3}\right)\right)\right)$$

Now:

$$\exp\left[jk\frac{p^2}{2k^2}(\vec{A}\cdot\vec{e}(t))\right] = 1+j\frac{p^2}{2k}(\vec{A}\cdot\vec{e}) + O\left(\frac{1}{k^2}\right) \tag{24}$$
$$= 1+O\left(j\frac{p^2}{2k}\right)$$

Consequently:

$$\frac{\partial \mathcal{F}}{\partial n} = jk(\vec{A}\cdot\vec{n})\cdot\exp\left[jk(\vec{A}\cdot\vec{e}) - p(\vec{A}'\cdot\vec{e})\right]\left(1-O\left(\frac{1}{k}\right)\right) + O\left(\frac{1}{k}\right) \tag{25}$$

More generally than Samans we have now the factor $\exp[-p(\vec{A}'\cdot\vec{e}(t))]$ under the sign of integration, but not influencing the position of the saddle point and the calculus of the integral, because for $k\to\infty$ this factor represents a "slowly variable function."

Samans's calculus runs by two methods of calculating integrals

a) some integrals disappear owing to Riemann-Lebesgue's lemma [5] S. 172
b) some integrals are evaluated by means of saddle points method (steepest descent, stationary phase).

In both cases $\exp[-p(\vec{A}'\cdot\vec{e}(t))]$ is the famous "slowly variable function". With this supposition we follow the calculus of Samans by inserting (20) (21) into equation (19) and verifying directly in an asymptotic manner.

Let us consider at first the case:
The point of observation $\vec{e}(s)$ placed on the illuminated side C_1 of the cylinder: (Fig. 2,3)

In order to verify the integral equation we have to show that in an asymptotic manner for $k\to\infty$

$$(26)\quad \mathcal{F} = \int_{C_1} \frac{\partial \mathcal{F}}{\partial n} \mathcal{H}_0^{(1)}(k\,r(t))\,dt \qquad \text{(see (18))}$$

where r denotes the distance between point of observation (s) and point of integration (t). If s is situated on C_1 the value $r(t)=0$ arises. For avoiding difficulties we transform the integral by means of Greens theorem so that $r=0$ is also contained in some intervals of integration indeed, but the integrals are easily evaluated.

As ($g = 0$ in the shady side) the integration is to be extended over the illuminated part C_1 of the circumference of the cylinder; we close this part by a stright line D, write Greens theorem for a position vector $\vec{e}$ outside of $\mathcal{G}$ (Fig.3), represent $\mathcal{F}$ by the incident wave on C_1 and D and in $\mathcal{G}$ and we have

$$(27)\quad \iint_{\mathcal{G}} \left(\mathcal{F}\,\Delta \mathcal{H}_0^{(1)}(kr) - \mathcal{H}_0^{(1)}(kr)\,\Delta \mathcal{F}\right) d\mathcal{G} = 0$$

This integral is equal to:

$$(28)\quad 0 = \int_{G+D} \left(F \frac{\partial \mathcal{H}_0^{(1)}(kr)}{\partial n} - \mathcal{H}_0^{(1)}(kr) \frac{\partial F}{\partial n} \right) dl$$

If $\vec{\mathcal{C}}(s)$ is displaced upon the border G_1, $\mathcal{G}$ is to be replaced by $\mathcal{G}'$ (Fig.4) where $\vec{\mathcal{C}}(s)$ is surrounded by a small half circle. Then we have

$$(29)\quad \int_{G+D+K} \left(F \frac{\partial \mathcal{H}_0^{(1)}}{\partial n} - \mathcal{H}_0^{(1)} \frac{\partial F}{\partial n} \right) dl = \int_{\lim K\to 0} F \frac{\partial \mathcal{H}_0}{\partial n} dl - \int_{\lim K\to 0} \mathcal{H}_0^{(1)} \frac{\partial F}{\partial n} dl$$
$$+ \int_{G_1} F \frac{\partial \mathcal{H}_0^{(1)}}{\partial n} dl - \int_{G_1} \mathcal{H}_0^{(1)} \frac{\partial F}{\partial n} dl + \int_{D} \left(F \frac{\partial \mathcal{H}_0^{(1)}}{\partial n} - \mathcal{H}_0^{(1)} \frac{\partial F}{\partial n} \right) dl$$

"$\lim K \to 0$" denotes that the half circle K is contracted to a radius $\to 0$.

By means of the well known development of $\partial \mathcal{H}_0^{(1)}(kr)/\partial r$ in $kr = 0$ we find ($\vec{n}$ = normal directed in the exterior of $\mathcal{G}$)

$$(30)\quad \int_{\lim K} F \frac{\partial \mathcal{H}_0^{(1)}}{\partial n} dl = -2j F$$

furthermore

$$(31)\quad \int_{\lim K} \mathcal{H}_0^{(1)} \frac{\partial F}{\partial n} dl \to 0$$; consequently (29) reduces itself to:

$$(32)\quad \int_{G_1} \mathcal{H}_0^{(1)} \frac{\partial F}{\partial n} dl = \frac{2}{j} F + \int_{G_1} F \frac{\partial \mathcal{H}_0^{(1)}}{\partial n} dl + \int_{D} \left(F \frac{\partial \mathcal{H}_0^{(1)}}{\partial n} - \mathcal{H}_0^{(1)} \frac{\partial F}{\partial n} \right) dl$$

and we have to demonstrate that the two integrales on the right hand side of (32) taken over G_1 and D disappear for $k \to \infty$. Some subsidiary calculus is effectuated in the appendices III, IV, V.

At first we have

$$\int_{C_1} \mathcal{F}\frac{\partial \mathcal{H}_0^{(1)}}{\partial n}\,dt = \int_{C_1} e^{-p(\vec{A}'\cdot\vec{e}(t))}\exp[jk(\vec{A}\cdot\vec{e}(t))]\times \tag{33}$$

$$\times\, k\,\mathcal{H}_1^{(1)}(k|\vec{e}(t)-\vec{e}(s)|)\,\vec{n}\cdot\frac{(\vec{e}(t)-\vec{e}(s))}{|\vec{e}(t)-\vec{e}(s)|}\,dt$$

It is easy to calculate: (See Samans)

$$\frac{\partial}{\partial n}\left(\mathcal{H}_0^{(1)}(k|\vec{e}(t)-\vec{e}(s)|\right) = \mathcal{H}_1^{(1)}(kr)\,k\cdot\vec{n}\cdot\frac{(\vec{e}(t)-\vec{e}(s))}{|\vec{e}(t)-\vec{e}(s)|}\ ; \tag{34}$$

with the notation

$$\vec{e}(t)-\vec{e}(s) = \vec{r} \qquad |\vec{e}(t)-\vec{e}(s)| = r = |\vec{r}| \tag{35}$$

we have Hankel's well known asymptotic representation of $\mathcal{H}_1^{(1)}$:

$$\mathcal{H}_1^{(1)}(kr) \sim -j\sqrt{\frac{2}{\pi k r}}\; e^{j(kr-\pi/4)}\left(1+O(1/kr)\right) \tag{36}$$

Inserting this representation into the integral (we refer to the appendices III, IV, V) we find for (33)

$$-j\sqrt{\frac{2k}{\pi}}\int_{C_1}(1/\sqrt{r})\exp\left[j(kr+(\vec{A}\cdot\vec{e}(t))-\tfrac{\pi}{4})-p(\vec{A}'\cdot\vec{e}(t))\right]\vec{n}\cdot\frac{\vec{r}}{r}\,dt \tag{37}$$

Corresponding Appendix IV it is easy to see, that on C_1 no stationary point is possible. In order to estimate the integral by means of Riemann-Lebesgue's lemma we have to study the influence of $1/\sqrt{r}$ for $r\to 0$. It is evident that there $\vec{n}\cdot\vec{r}/r$ is of the order of r/ρ (ρ = radius of curvature $\neq 0$) $r/\rho \approx t/\rho$ (t = length of the curve). The integrand is every where finite and by App. III we have

$$\int_{C_1}\mathcal{F}\frac{\partial \mathcal{H}_0^{(1)}}{\partial n}\,dt = O\left(\frac{1}{\sqrt{k}}\right) \tag{38}$$

The two parts of the integral over $\mathcal{D}$ are found in the following way:

$\mathcal{F}$ was the function of the incident wave on $\mathcal{D}$.
Then there exists a stationary point of the second kind evident from fig. 11.

(39) $\vec{n} = \vec{A} = \dfrac{\vec{\varrho}(t) - \vec{\varrho}(s)}{|\vec{\varrho}(t) - \vec{\varrho}(s)|}$

Appendix III, theorem 2 shows the calculus of the saddle-point integral:
With the notations of App. III, IV, we have

(40) $h(t) = (\vec{A} \cdot \vec{\varrho}(t)) + |\vec{\varrho}(t) - \vec{\varrho}(s)|$

Than from Ap. . IV we see:

(41) $h'(t) = (\vec{A} \cdot \vec{t}) + \left(\dfrac{(\vec{\varrho}(t) - \vec{\varrho}(s))}{|\vec{\varrho}(t) - \vec{\varrho}(s)|} \cdot \vec{t}\right)$

By means of well known theorems on curves (f.i. [7] p. 321 ff, text books on differential geometry) we find:

$$h''(t) = (\vec{A} \cdot \vec{n})\varkappa + \frac{1}{|\vec{\varrho}(t) - \vec{\varrho}(s)|} -$$

(42) $$- \frac{[(\vec{\varrho}(t) - \vec{\varrho}(s)) \cdot \vec{t}]^2}{|\vec{\varrho}(t) - \vec{\varrho}(s)|^3} + \varkappa\left(\vec{n} \cdot \frac{(\vec{\varrho}(t) - \vec{\varrho}(s))}{|\vec{\varrho}(t) - \vec{\varrho}(s)|}\right)$$

where $\varkappa$ represents the curvature of the border in the saddlepoint $t = \tau$; now $\mathcal{D}$ is a stright line, $\varkappa = 0$; in the saddlepoint $(\vec{\varrho}(t) - \vec{\varrho}(s))$ has the direction of the normal, consequently $(\vec{\varrho}(t) - \vec{\varrho}(s))\vec{t} = 0$ and

(43) $h''(t) = \dfrac{1}{|\vec{\varrho}(t) - \vec{\varrho}(s)|} > 0,\ t = \tau$ in the saddle point

consequently:

(44) $$\int_{\mathcal{D}} \mathcal{F} \frac{\partial H_0^{(1)}}{\partial n} du = 2j e^{jk(|\vec{\varrho}(\tau) - \vec{\varrho}(s)| + (\vec{A} \cdot \vec{\varrho}(\tau)) + j(\vec{A}' \cdot \vec{\varrho}(\tau))p)} + O(1/\sqrt{k})$$

Taking into account the well known asymptotic representation of $\mathcal{H}_0^{(1)}(kr)$

(45) $\mathcal{H}_0^{(1)}(kr) \sim \sqrt{\frac{2}{\pi r k}}\, e^{j(kr-\frac{\pi}{4})}$ we get analogously to (44)

$$\int_{\mathcal{D}} \mathcal{H}_0^{(1)} \frac{\partial \mathcal{F}}{\partial n} dl = 2j\, e^{jk(|\vec{q}(\tau)-\vec{q}(s)|+(\vec{A}\cdot\vec{q}(\tau))+j(\vec{A}'\cdot\vec{q}(\tau))p)} + O\left(\frac{1}{\sqrt{k}}\right) \tag{46}$$

Here we have $(\vec{A}\cdot\vec{n}) = 1$ $\vec{n}$ parallel to $\vec{A}$
Collecting (26) (28) (30) (31) (32) (45) (46) then (26) is verified.

In the case $\vec{q}(s)$ on the illuminated zone of cylinder the integral equation (12) (19) is now resolved in an asymptotic manner for $k \to \infty$ by (20) and we turn ourselves to the analogous solution, if $\vec{q}(s)$, i.e. $\mathcal{P}$ is situated in the shadow zone. Also in this case, Samans's calculus is only modified by the slowly variable function $\exp[-p(\vec{A}'\vec{q}(\tau)]$. $r=0$ is excluded here because in the neighbourhood of $\mathcal{P}$ $g=0$.
On C_1 there exists a stationary point of first kind (App. II, IV, V, see Fig. 12)

$$\vec{A} = -\frac{(\vec{q}(t)-\vec{q}(s))}{|\vec{q}(t)-\vec{q}(s)|} \qquad \text{for } t=\tau \tag{47}$$

Only this part of the exponent determines the saddle point, that contains k. $\exp[-p(\vec{A}'\cdot\vec{q})]$ is again slowly variable. We have

$$\mathcal{F} = \exp\left[jk(\vec{A}\cdot\vec{q})\sqrt{1+\frac{p^2}{k^2}} - p(\vec{A}'\cdot\vec{q})\right] \tag{16}$$

$$\frac{\partial \mathcal{F}}{\partial n} = jk(\vec{A}\cdot\vec{n})\exp\left[jk(\vec{A}\cdot\vec{q})\sqrt{1+\frac{p^2}{k^2}} - p(\vec{A}'\vec{q})\right] + O\left(\frac{1}{k}\right) \tag{25}$$

Then the function $\varphi(\tau)$ (see App. III,IV) is

$$(48)\quad \varphi(\tau) = \exp[-p(\vec{A}'\cdot\vec{\varrho}(\tau))]\cdot\frac{jk(\vec{A}\cdot\vec{n})}{|\vec{\varrho}(\tau)-\vec{\varrho}(s)|^{1/2}}$$

From equation (42) (being valuable for $\mathcal{H}_0^{(1)}$ and $\mathcal{H}_1^{(1)}$ in the integrand) we see:

$$(49)\quad (\vec{A}\cdot\vec{n}) = -1\ ,\quad \vec{n}\cdot\frac{(\vec{\varrho}(\tau)-\vec{\varrho}(s))}{|\vec{\varrho}(\tau)-\vec{\varrho}(s)|} = +1$$

and

$$(50)\quad h''(\tau) = \frac{\left(\frac{((\vec{\varrho}(\tau)-\vec{\varrho}(s))\cdot\vec{n})}{|\vec{\varrho}(\tau)-\vec{\varrho}(s)|}\right)^2}{|\vec{\varrho}(\tau)-\vec{\varrho}(s)|} > 0$$

Consequently:

$$(51)\quad \int_{C_1} g(t)\mathcal{H}_0^{(1)}dt = jk\int_{C_1}\frac{(\vec{A}\cdot\vec{n})}{\sqrt{r(t)}}\sqrt{\frac{2}{k\pi}}\,e^{-p(\vec{A}'\cdot\vec{\varrho}(t))+jk(\vec{A}\cdot\vec{\varrho})}\times e^{jkr(t)}\left(1+O\left(\tfrac{1}{k}\right)\right)dt$$

This integral furnishes by saddle points method

$$(52)\quad jk(\vec{A}\cdot\vec{n})\left[\frac{2\pi}{kh''(\tau)}\right]^{1/2}\sqrt{\frac{2}{k\pi r(\tau)}}\,e^{jk(r(\tau)+(\vec{A}\cdot\vec{\varrho}(\tau))+j(\vec{A}'\cdot\vec{\varrho}(\tau)))}+O\left(\frac{1}{\sqrt{k}}\right) = -2j\,e^{jk(\vec{A}\cdot\vec{\varrho}(s))+jp(\vec{A}'\cdot\vec{\varrho}(s))}$$

Here we take into account that (Fig. 8)

$$(53)\quad (\vec{A}'\cdot\vec{\varrho}(\tau)) = (\vec{A}'\cdot\vec{\varrho}(s))$$

furthermore (eq. (1) in App. IV)

$$(54)\ \left(\left(\vec{\varrho}(\tau) - \vec{\varrho}(s)\right)\vec{\mathcal{A}}\right) = -\left|\left(\vec{\varrho}(\tau) - \vec{\varrho}(s)\right)\right|$$

and therefore:

$$(55)\ \left(\vec{\mathcal{A}} \cdot \vec{\varrho}(\tau)\right) + \left|\vec{\varrho}(\tau) - \vec{\varrho}(s)\right| = \left(\vec{\mathcal{A}} \cdot \vec{\varrho}(s)\right)$$

Thus the integral equation is verified by (56) also in the case: $\vec{\varrho}(s)$, point of observation situated in the shady zone.

For $k \to \infty$ in an asymptotic manner we have shown:

Let a transversally attenuated wave, the direction of incidence of which is defined by the phase normal = real part of Poyntings vector, be diffracted by a smooth zylinder; the boundary condition is u = 0, then there exists exactly as in the case of a homogenous wave an illuminated an a shady zone; the limit between illuminated and shadow zone is defined by geometrical optics if wave normals are defined as rays.

That is to say that these wave normals are to be considered as analytic continuation of rays for Kellers theory. This could serve as a supplement to this theory.

Only in the point: limit between shadow and illuminated zone the integral equation is not fullfilled. This point is a set of Lebesgues measure zero, not influencing the value of an integral.

2.2 Watsons Transformation - Creeping Waves on the Surface of Cylinders and Spheres for Incident transversally Attenuated Waves

In the following chapter we wish to treat a series of problems concerning the diffraction of transversally attenuated waves:

1) For an incident transversally attenuated electromagnectic wave we shall establish the solution of the problem of diffraction by an infinitely conducting sphere. The classic series developments of Debyes potentials are extended to this "inhomogenous" case. It turns out, that the usual series following Legendres functions do not more converge on the whole surface of the sphere and we shall see that in this case Watsons Transformation gives an analytic continuation of the development in the shady zone.
2) Watson waves are often noted as "creeping waves" [4] and we intend to study their distortion by transversal attenutation in the shady zones of cylinders and spheres.

2.2.1 Debye's Potentials on the Sphere for the Incidence of Transversally Attenuated Waves

In a famous paper [8] Debye has given 1909 the first complete solution of the diffraction of a plane homogenous electromagnetic wave by a sphere consisting of any material, containing also the infinitely conducting sphere. The theory of diffraction has made tremendous progresses since this time: The first one consisted of the introduction of Watsons transformation 1918 [9] [10] [11] . In these papers are involved the "Watson-waves" denoted later on by Franz [4] "creeping waves". We intend to study the distortion of these waves by transversal attentuation of the incident plane wave; from 2.1) we take the certainty, that the shadow is limited by "limiting rays", defined as wave normals. Readers of Debyes paper may take into account that this author uses $\exp[+j\omega t]$ as a time function, whereas we prefer $\exp[-j\omega t]$. We shall consider the primary

wave as incident under an angle $-ja$, then we have to continue Debyes expressions into the domain of complex angles after changing $+j\omega t$ with $-j\omega t$.

For reasons of rigour we cannot avoid to follow general lines of Debye in our case of an inhomogenous incident wave. It will turn out a direct analytic continuations of Debyes results for our case.

Debye supposes a homogenous plane wave incident in the-z-direction, $\vartheta = \pi$ or in the direction opposite to $\vartheta = 0$. Now we (Fig.9) turn the system of coordinates so that the new pole is situated in $\varphi = 0,\ \vartheta = \vartheta'$. With reference to the invariance of Maxwells equations and the wave equation against rotations we write down the incident inhomogenous wave:

$$(1)\quad E_y = \exp\left[-jkz\cosh a - kx\sinh a\right]^{x)}$$

$$(2)\quad H_x = \frac{1}{Z}\cosh a \exp\left[-jkz\cosh a - kx\sinh a\right]$$

$$(3)\quad H_z = \frac{j}{Z}\sinh a \exp\left[-jkz\cosh a - kx\sinh a\right]$$

$Z =$ Wave-impedance

E is supposed as perpendicular to the direction of attenuation. The "dual" case, H perpendicular to this direction is not treated in this paper.

As "plane of incidence" we define the plane of the wave normal and the direction of attenuation. If we turn the zenith of the sphere from $\vartheta = 0$ into $\vartheta = \vartheta'$

x) Debye supposes E_x, this produces the exchange of $\cos\psi$ for $\sin\psi$ and ν, ν. later on.

in the meridian $\varphi = 0$ (Fig.14) then we have from spherical trigonometry: (see Fig.9)

$$(4)\quad \cos\gamma = \cos\vartheta\cos\vartheta' + \sin\vartheta\sin\vartheta'\cos\psi$$

$$(5)\quad \sin\gamma\sin\psi = \sin\vartheta\sin\varphi .$$

In a x,y,z-System this would be a transition to a new system by conserving the y-axis.

The wave, chosen by Debye, coming from $\vartheta = 0$, has the form (in our MKS units)

$$(6)\quad E_y = e^{-jkz} \quad , \quad H_x = \frac{1}{Z} e^{-jkz}$$

The rotation of the x,z-plane into the x',z' plane furnishes (see Fig.15)

$$(7)\quad z' = z\cos\vartheta' + x\sin\vartheta'$$

$$(8)\quad x' = -z\sin\vartheta' + x\cos\vartheta'$$

Then the wave coming from ϑ' is given by:

$$(9)\quad E_{y'} = e^{-jkz'} \qquad H_{x'} = \frac{1}{Z} e^{-jkz'}$$

or

$$(10)\quad E_{y'} = \exp[-jk(z\cos\vartheta' + y\sin\vartheta')], \quad H_{x'} = \frac{1}{Z} E_{y'}$$

With (11) $z = R\cos\vartheta,\ x = R\sin\vartheta\cos\varphi,\ y = R\sin\vartheta\sin\varphi$ we have

$$(12)\quad E_y = E_{y'} = \exp[-jkR(\cos\vartheta\cos\vartheta' + \sin\vartheta\sin\vartheta'\cos\varphi)]$$
$$= \exp[-jkR\cos\gamma] \quad \text{(foll. (4))}$$

Now we put

(13) $$\vartheta' = -ja$$

and we shall see that (1) will arise from (12),

(14) $$\cos\gamma = \cos\vartheta\cosh a - j\sin\vartheta\sinh a\cos\varphi$$

and

(15) $$E_{y'} = \exp[-jkz\cosh a - kx\sinh a] = E_y$$

from E_y, H_x, H_z we have now to look for
$E_R, E_\vartheta, E_\varphi, H_R, H_\vartheta, H_\varphi$:

(16) $$E_R = \exp[-jkR\cos\gamma]\sin\vartheta\sin\varphi = \exp[-jkR\cos\gamma]\sin\gamma\sin\varphi$$

(17) $$E_\vartheta = \exp[-jkR\cos\gamma]\cos\vartheta\sin\varphi$$

(18) $$E_\varphi = \exp[-jkR\cos\gamma]\cos\varphi$$

(19) $$H_R = \frac{1}{Z} E_y \cdot (-\sin\vartheta'\cos\vartheta + \cos\vartheta'\sin\vartheta\cos\varphi)$$

(20) $$H_\vartheta = \frac{1}{Z} E_y \cdot (\cos\vartheta'\cos\vartheta\cos\varphi - \sin\vartheta'\cos\vartheta\sin\varphi)$$

(21) $$H_\varphi = -\frac{1}{Z} E_y \cdot \cos\vartheta\sin\varphi, \text{ with } \vartheta' = -ja.$$

Refering to Debye [8] and [11] we are now able to establish the development of the incident wave after Debye, where ϑ is replaced by γ, φ by ψ .

The domains of convergence will be discussed after treating the reaction of the infinitely conducting sphere.

We wish to chose another definition of some functions as Debye and we give the definitions of our functions:

(22) $$P_n^1(\cos\vartheta) = \sin\vartheta \frac{d}{d\cos\vartheta} P_n(\cos\vartheta)$$

(23) $P_n(\cos\vartheta) = P_n^0(\cos\vartheta)$ = nth polynom of Legendre

Furthermore we wright:

(24) $$\psi_n(kR) = \sqrt{\frac{\pi}{2kR}}\, J_{n+\frac{1}{2}}(kR)$$

(25) $$\zeta_n^{(1)}(kR) = \sqrt{\frac{\pi}{2kR}}\, H_{n+\frac{1}{2}}^{(1)}(kR)$$

(26) $$\zeta_n^{(2)}(kR) = \sqrt{\frac{\pi}{2kR}}\, H_{n+\frac{1}{2}}^{(2)}(kR)$$

For understanding we note Debyes notations:

(27) $$\psi_{n\,Debye}(kR) = kR\,\psi_n(kR)$$

(28) $$\eta_{n\,Debye}(kR) = kR\,\zeta_n^{(1)}(kR)$$

(29) $$\zeta_{n\,Debye}(kR) = kR\,\zeta_n^{(2)}(kR)$$

Debye derives the components of field vectors from a magnetic potential Π_m and an electric potential Π_e

In MKS - Giorgi -units we have for Π_e :

(30) $E_R = \frac{\partial^2 R\Pi_e}{\partial R^2} + k^2 R\Pi_e$

(31) $E_\vartheta = \frac{1}{R} \frac{\partial^2 R\Pi_e}{\partial R \partial \vartheta}$

(32) $E_\varphi = \frac{1}{R \sin\vartheta} \frac{\partial^2 R\Pi_e}{\partial R \partial \varphi}$

(33) $H_R = 0$

(34) $H_\vartheta = \frac{-j\omega\varepsilon_0}{R \sin\vartheta} \frac{\partial R\Pi_e}{\partial \varphi}$

(35) $H_\varphi = \frac{j\omega\varepsilon_0}{R} \frac{\partial R\Pi_e}{\partial \vartheta}$

The magnetic potential Π_m gives:

(36) $E_R = 0$

(37) $E_\vartheta = \frac{j\omega\mu_0}{R \sin\vartheta} \frac{\partial R\Pi_m}{\partial \varphi}$

(38) $E_\varphi = \frac{-j\omega\mu_0}{R} \frac{\partial R\Pi_m}{\partial \vartheta}$

(39) $H_R = \frac{\partial^2 R\Pi_m}{\partial R^2} + k^2 R\Pi_m$

(40) $H_\vartheta = \frac{1}{R} \frac{\partial^2 R\Pi_m}{\partial R \partial \vartheta}$

(41) $H_\varphi = \frac{1}{R \sin\vartheta} \frac{\partial^2 R\Pi_m}{\partial R \partial \varphi}$

Both potentials are solutions of the wave equation:

(42) $$\Delta \Pi_{\substack{e \\ m}} + k^2 \Pi_{\substack{e \\ m}} = 0$$

It is well known that ([3] p. 545) we can write:
($\Pi_{\substack{e \\ m}}$ is supposed being scalar, $\vec{r}$ unity vector in the direction of increasing R)

(43) $$\vec{E} = \nabla \times \nabla \times (\vec{r}\,\Pi_e) + jk(\nabla \times (\vec{r}\,\Pi_m))$$

(44) $$Z\vec{H} = \nabla \times \nabla \times (\vec{r}\,\Pi_m) - jk(\nabla \times (\vec{r}\,\Pi_e))$$

where $Z = \sqrt{\frac{\mu_0}{\varepsilon_0}} = 120\pi\,\Omega$ wave impedance of the vacuum.

Then by analytic continuation to the angle of incidence $-ja$ and transition to $\exp[-j\omega t]$ the potentials of the

incident wave are:

(45) $$\Pi_{ei} = \sum_{n=1}^{\infty} \frac{(-j)^{n-1}}{k} \frac{(2n+1)}{n(n+1)} \psi_n(kR)\, P_n^1(\cos\gamma) \sin\psi$$

(46) $$\Pi_{mi} = \frac{1}{Z} \sum_{n=1}^{\infty} \frac{(-j)^{n-1}}{k} \frac{(2n+1)}{n(n+1)} \psi_n(kR)\, P_n^1(\cos\gamma) \cos\psi$$

$\frac{1}{Z}$ comes from our use of Giorgi's MKS Units. Debye has E_x as an incident wave, we have E_y and so $\cos\psi$, $\sin\psi$ are changed, ψ is defined by (5).
In their domains of convergence these series are to be summed and they furnish following Debye and continued to complex angles:

(47) $$\Pi_e = \frac{\sin\psi}{k} \frac{1}{kR} \left\{ \frac{e^{-jkR\cos\gamma}}{\sin\gamma} - \frac{e^{-jkR}}{2} \operatorname{ctg}\frac{\gamma}{2} - \frac{e^{jkR}}{2} \operatorname{tg}\frac{\gamma}{2} \right\}$$

(48) $$\Pi_m = \frac{\cos\psi}{k} \frac{1}{kR} \left\{ \frac{e^{-jkR\cos\gamma}}{\sin\gamma} - \frac{e^{-jkR}}{2} \operatorname{ctg}\frac{\gamma}{2} - \frac{e^{jkR}}{2} \operatorname{tg}\frac{\gamma}{2} \right\}$$

This is shown by Debye for $\gamma = \vartheta$, analytic continuation is valid. Debye does not give explicitely the origine of the terms with $\operatorname{ctg}\frac{\gamma}{2}, \operatorname{tg}\frac{\gamma}{2}$:
The series have to represent an entire solution of the wave equation. These terms, due to solutions of Legendres equation not contained in the system of spherical harmonics produce regularity of Π_e and Π_m in $\gamma = 0$ and $\gamma = \pi$.

2.2.2) Fullfilling Boundary Conditions for Π_e and Π_m on the Surface of the Infinitely Conducting Sphere for Transversally Attenuated Incident Waves.

To these series we have to add another ones representing waves outgoing from the surface of the sphere. The boundary conditions are:

(49) $$\frac{\partial R\Pi_e}{\partial R} = 0$$ (50) $$R\Pi_m = 0 \quad \text{in } R = R_0$$

Using (25) we shall now establish the expressions of waves, outgoing from the sphere: with coefficients A_n^1 and A_n^2 we have:

(51) $$\Pi_{e0} = \frac{1}{k}\sum_{n=1}^{\infty} A_n^1 \zeta_n^{(1)}(kR) P_n^1(\cos\gamma)\sin\psi$$

(52) $$\Pi_{m0} = \frac{1}{k}\sum_{n=1}^{\infty} A_n^2 \zeta_n^{(1)}(kR) P_n^1(\cos\gamma)\cos\psi$$

A_n^1 and A_n^2 are easily found by means of (45) (46) (49) (50). Finally we have for the complete potentials Π_e and Π_m : (R_0 = radius of the diffracting sphere)

(53) $$\Pi_e = \frac{\sin\psi}{k}\sum_{n=1}^{\infty}(-j)^{n-1}\frac{2n+1}{n(n+1)} P_n^1(\cos\gamma)\left\{\psi_n(kR) - \zeta_n^{(1)}(kR)\frac{\frac{\partial}{\partial R}\left(R\psi_n(kR)\right)_{R_0}}{\frac{\partial}{\partial R}\left(R\zeta_n^{(1)}(kR)\right)_{R_0}}\right\}$$

(54) $$\Pi_m = \frac{\cos\psi}{k}\sum_{n=1}^{\infty}(-j)^{n-1}\frac{2n+1}{n(n+1)} P_n^1(\cos\gamma)\left\{\psi_n(kR) - \zeta_n^{(1)}(kR)\frac{\psi_n(kR_0)}{\zeta_n^{(1)}(kR_0)}\right\}$$

It is evident that (53) (54) give the analytic continuation of Debyes series by replacing of ϑ, φ by γ, ψ. However we needed the calculus above for proofing the addmissibility of our procedure from a physical point of view.

2.2.2.1 Remarks on the Convergence of the Series Following Spherical Harmonis

Such a series, written in $\cos\gamma$, represents series following powers of $\cos\gamma$; it converges inside of the unit circle, since $\cos\gamma = \pm 1$ are the irregularities next to the origin. If the angle of incidence is real convergence is extended over the surface of the sphere. But if $\cos\gamma$ for a value of a, sufficiently great is not more inside the unity circle the series is not more convergent and we have to look for an analytic continuation. This continuation is obtained by means of Watsons transformation. In what follows we shall see how this continuation is effected. We shall see, that the integral representing (53)or(54) reduces itself to the sum of residues of Watson waves, converging well only in the shady zone indeed. But this convergence in the shady zone is valid for any $\cos\gamma$.

2.2.2.2 Watsons Transformation Furnishes an Analytic Continuation of Debyes Series

In the following text we restrict ourselves to the series for Π_m (54). For a value of γ, where (54) converges, we execute Watsons transformation into an integral long an infinite halfcircle and a sum of residues. The integral over the half-circle will disappear, and the sum of the residues representing creeping waves will arise. Now we see, that this integral disappears also, if the series (54) is not more convergent and the series of Watson residues remains convergent. This affirmation is to be proofed.

Studying Π_m we consider that Π_m is zero on the surface of the sphere. We are interested an Π_m for $R > R_0$.

The sum in question is

$$(54)\quad T_{m} = \frac{\cos\psi}{2R}\sum_{n=1}^{\infty}(-j)^{n-1}\frac{(2n+1)}{n(n+1)}P_n^1(\cos\gamma)\left(\psi_n(kR)-\zeta_n^{(1)}(kR)\frac{\psi_n(kR_0)}{\zeta_n^{(1)}(kR_0)}\right)$$

By introducing a continous parameter ν we transform in a well known manner this sum into an integral over the path of Fig. 11. The integral runs as follows

$$(55)\quad T_{m} = \frac{j\cos\psi}{2\pi 2k}\int_C \frac{e^{j(\nu-1)\frac{\pi}{2}}}{\sin\nu\pi}\frac{(2\nu+1)}{\nu(\nu+1)}P_\nu^1(\cos\gamma)\frac{\psi_\nu(kR)\zeta_\nu^{(1)}(kR_0)-\zeta_\nu^{(1)}(kR)\psi_\nu(kR_0)}{\zeta_\nu^{(1)}(kR_0)}\,d\nu$$

There arises the possibility to write in an usual manner

$$(56)\quad P_n^1(\cos\gamma) = (-1)^{n+1}\,P_n^1(\cos(\pi-\gamma))$$

But we shall not use this form for the present.
Putting

$(57)\quad \nu = s-\frac{1}{2}$ we show that the integrand is an odd function of s $(\nu=0:\ s=\frac{1}{2})$

We see

$$(58)\quad P_\nu^1(\cos\gamma) = P_{-\nu-1}^1(\cos\gamma),\quad P_{s-\frac{1}{2}}^1(\cos\gamma) = P_{-s+\frac{1}{2}-1}^1(\cos\gamma) = P_{-s+\frac{1}{2}}(\cos\gamma)$$

is an even function of s

$(59)\ 2\nu+1 = 2s$ is an odd function of s

$(60)\ \nu(\nu+1) = s^2-\frac{1}{4}$ is an even function of s

$(61)\ \frac{1}{\sin\nu\pi} = -\frac{1}{\cos s\pi}$ is an even function of s

$(62)\ \left(\psi_\nu(kR)\zeta_\nu^{(1)}(kR_0)-\psi_\nu(kR_0)\zeta_\nu^{(1)}(kR)\right)$ is an even function of s by virtue of well known theorems on Besselfunctions.

Likewise

(63) $e^{j\frac{\nu\pi}{2}} \zeta_{\nu}(kR)$ is an even function of s so that

because of (59) the integrand is an odd function of s . Consequently the path of integration of Fig. 11 can be replaced by the path of Fig. 12. The integral along the imaginary axis disappears because the integrand is odd, it is to be shown that the integral along the half-circle goes $\rightarrow 0$ for $R \rightarrow \infty$ and it remains only the sum of residues on the first quadrant. Then is to be proved that the sum of residues converges also for an imaginary angle of incidence. (any value of $\cos\mu$). By this consideration we see again that the sum of creeping Watson waves resolves the problem in the shady zone. Refering to Franz [1] p. 35/6 (see Fig.13) we give the situation of the mentioned chain of poles.

The line on which the poles are situated begins on the real s-axis in $s = kR_0$ under an angle of $\pi/3$ and becomes parallel to the imaginary axis for $\Im m\, S \rightarrow \infty$ Following Franz l.c. we put

$$(64) \quad S = \rho e^{i\chi} \;, \quad \chi = \frac{\pi}{2} - \alpha$$

In order to estimate the integral for $R \rightarrow \infty$ between the imaginary axis and the line of poles, following Franz we have to treat it between $\alpha = 0$ and $\alpha = \alpha'$ with

$$(65) \quad s = \frac{kR_0}{2} e^{\frac{\pi}{2\alpha'}} \cdot \exp\left[j\left(\frac{\pi}{2} - \alpha'\right)\right] \qquad \text{thus}$$

$$(66) \quad \rho = \frac{kR_0}{2} e^{\pi/2\alpha'} \;, \quad \frac{\pi}{2\alpha'} = \ln\frac{2\rho}{kR_0} \;, \quad \alpha' = \frac{\pi}{2\ln\frac{2\rho}{kR_0}}$$

The asymptotic representation of the spherical harmonics [12] [13] [14] [15] runs as follows:

Defining

(67) $z = \cosh \zeta$ we have

(68) $$P_s^1(z) \sim \sqrt{\frac{s}{\pi}} \frac{e^{\pm \zeta}}{(1+e^{-2\zeta})^{\frac{1}{2}}} \left\{ e^{(s+\frac{1}{2})\zeta} + e^{\mp j\frac{\pi}{2}} e^{-(s+\frac{1}{2})\zeta} \right\}_{s\to\infty}$$

- for s in the upper
+ for s in the lower half plane.

Using Watsons method we have to estimate the integral at first on the far half circle; at first in $0 \leq \alpha \leq \alpha'$
We put

(69) $\cos\gamma = \cosh\zeta$, $\gamma = \pm j\zeta$ and

(70) $\gamma = \Theta + j\Theta'$

(71) $\cos\gamma = \cos\Theta \cosh\Theta' - j\sin\Theta \sinh\Theta'$

We had in the integral $P^1_{s-\frac{1}{2}}(\cos\gamma)$, therefore we need

(see 68) $e^{\pm s\zeta}$ $0 \leq \alpha \leq \alpha'$.

With increasing $\varrho \to \infty$, α' decreases $\to 0$. In the mentioned α-intervall we write:

(69) $$s - \tfrac{1}{2} = \varrho\, e^{j(\frac{\pi}{2}-\alpha)} = j\varrho\, e^{-j\alpha} \approx j\varrho(1-j\alpha) = j\varrho + \varrho\alpha$$

and

(70) $$e^{\pm s\zeta} = e^{\pm(j\varrho+\varrho\alpha)(j\Theta-\Theta')}$$
$$= \exp\left[\pm(-\varrho)(\Theta+\alpha\Theta') \pm j(\Theta'-\alpha\Theta)\right]$$

The asymptotic values of the factors in the integrand are

$$(71)\quad \left[\psi_\nu(kR)\zeta_\nu^{(1)}(kR_0)-\psi_\nu(kR_0)\zeta_\nu^{(1)}(kR)\right]\sim\frac{2}{j\pi}\left(\left(\frac{R}{R_0}\right)^s-\left(\frac{R_0}{R}\right)^s\right)$$

wherein $R > R_0$ (the point of observation lies outside of the sphere). (Franz [4])

Furthermore:

$$(72)\quad \frac{1}{\zeta_s^{(1)}(kR_0)}\sim\begin{cases}\frac{s\pi}{2j}\left(\frac{2s}{ekR_0}\right)^s\sqrt{\frac{2kR_0}{\pi}}\sqrt{\frac{2}{\pi s}} : 0<\alpha<\alpha' \\ \frac{s\pi}{j}\frac{1}{\sqrt{2\pi s}}\left(\frac{ekR_0}{2s}\right)^s\sqrt{\frac{2kR_0}{\pi}} : \alpha'<\alpha<\frac{\pi}{2} \\ j\sqrt{\frac{2}{\pi s}}\left(\frac{2s}{ekR_0}\right)^s\sqrt{\frac{2kR_0}{\pi}} : \frac{\pi}{2}>\alpha>\pi\end{cases}$$

and

$$(73)\quad P'_{s-\frac{1}{2}}(\cosh\zeta)\sim\sqrt{\frac{s-\frac{1}{2}}{\pi}}\,\frac{1}{\sqrt{e^{\zeta}-e^{-\zeta}}}\left\{e^{s\zeta}\mp j\,e^{-s\zeta}\right\}$$

We shall see that it is sufficient to study the integral on the far half circle in $0\leq\alpha\leq\alpha'$, as in $\alpha'<\alpha<\pi$ it converges a fortiori for $\rho\to\infty$.

Writing down the integral in $0<\alpha<\alpha'$, we have four products due to the 2 terms in the right hand side of (71) and the two terms in the asymptotic representation of $P'_{s-1/2}$ (73). From these products we select the most unfavorable one what concerns convergence:

$$(74)\quad \exp\left[\ln\left(\frac{R}{R_0}\right)\cdot(\rho\alpha+jR)\right]\exp\left[\rho(\theta+\theta'\alpha)+j\rho(\alpha'\theta-\theta')\right]$$
$$\theta>0,\ \theta'\alpha>0$$

If Θ and $\Theta'\alpha$ change their signs, the term with $\exp[-\varrho(\cdots)]$ is to be considered, the formal expression is conserved. Thus we have T^x_{mn}, the part of the integral in $\alpha \to \alpha'$,

$$(75)\quad T^x_{mn} = \frac{e^{-j\frac{3\pi}{4}}\cos\omega}{2j\sqrt{2k}} \int_{\alpha=0}^{\alpha'} \frac{e^{j\Phi}}{\cos\tau}\,\frac{2}{s}\,P^1_s(\cos\vartheta)\sqrt{\frac{\pi}{2kR}}\;\frac{J_s(kR)H^{(1)}_s(kR_0)-J_s(kR_0)H^{(1)}_s(kR)}{H^{(1)}_s(kR_0)}\,ds$$

This becomes by use of (71) (72) (73) with a constant factor K:

$$(76)\quad T^x_{mn} \sim K \int_{\alpha=0}^{\alpha=\alpha'} \frac{\exp[3js\frac{\pi}{2}]}{s}\, e^{s\ln\varrho/R_0} \left(\frac{2s}{ekR_0}\right)^s e^{s\zeta}\,ds$$

with $\zeta = j\theta - \theta'$

we are able to write:

$$(77)\quad e^{j\frac{3\pi}{2}s} = e^{j\frac{\pi}{2}\varrho 3(\alpha+j)} = e^{-\frac{3\pi}{2}\varrho}\, e^{j\frac{3\pi}{2}\alpha\varrho}$$

$$\frac{1}{s} = \frac{1}{\varrho(\alpha+j)} = \frac{1}{j\varrho(1-j\alpha)} \approx \frac{1+j\alpha}{j\varrho} = \frac{\alpha}{\varrho} - \frac{j}{\varrho}$$

$$1+j\alpha \sim \frac{1}{1-j\alpha}$$

$$e^{s\ln\frac{\varrho}{R_0}} = e^{\varrho(\alpha+j)\ln\frac{\varrho}{R_0}} = e^{\varrho\alpha\ln\frac{\varrho}{R_0} + j\varrho\ln\frac{\varrho}{R_0}}$$

$$\left(\frac{2s}{ekR_0}\right)^s = e^{s\ln\frac{2s}{ekR_0}} = e^{\varrho\left(\alpha\ln\frac{2\varrho}{ekR_0} - \frac{\pi}{2} + \alpha\right) + j\varrho\left(\ln\frac{2\varrho}{ekR_0} + \frac{\pi}{2}\alpha\right)}$$

$$e^{-s\zeta} = e^{-\varrho(\alpha+j)(j\theta-\theta')} = e^{\varrho(\theta'\alpha+\theta) + j\varrho(\theta\alpha-\theta')}$$

The integral (75) is to be estimated by means of (76) (77). It takes the form:

$$(78)\quad \lim_{\varrho\to\infty} e^{-2\pi\varrho+\varrho\theta-j\theta'+j\varrho K_3}\int_{\alpha=0}^{\alpha=\alpha'} \exp[\varrho\alpha(K_1+jK_2)]\,d\alpha$$

where

$$(79)\quad K_1 = \ln\frac{R}{R_0} + \ln\frac{2\varrho}{e\pi R_0} + 1 + \theta', \quad K_2 = 2\pi + \theta$$

$$K_3 = \ln\frac{R}{R_0} + \ln\frac{2R}{e\pi R_0} - \theta'$$

(79) gives

$$(80)\quad \lim_{\varrho\to\infty} e^{-2\pi\varrho+\varrho\theta}\,\frac{\exp[\varrho\alpha'(K_1+jK_2)-1]}{\varrho\,[K_1+K_2]}$$

This value disappears for $\varrho\to\infty$ if:
at first

$$(81)\quad \frac{-1\, e^{-2\pi\varrho+\varrho\theta}}{\varrho\,(K_1+jK_2)} \to 0 \;:\; \theta \leq 2\pi$$

The other condition would be:

$$(82)\quad -2\pi\varrho+\varrho\theta+\varrho\left(\frac{\pi}{2\ln\frac{2\varrho}{e\pi R_0}}\cdot\ln\frac{R}{R_0}+\frac{\pi}{2}+\frac{\pi(1+\theta')}{2\ln\frac{2\varrho}{e\pi R_0}}\right) < 0$$

for $\varrho\to\infty$

(Imaginary parts in the exponent do not influence the absolute value) ; it follows:

$$(83)\quad \theta < \frac{3\pi}{2} \qquad \theta' \text{ any fixed value}$$

If these condition is fullfilled, the integral taken over the other parts disappears a fortiori.

Thus for $\gamma = \theta + j\theta'$ in a stripe $0 < \theta < 3\pi/2$, the solution of the diffraction problem in the shady zone by Watsons transformation is justified, if we can show, that this series of residues converges for any $|\cos\gamma|$. It is essential that in the limit the sequence of poles is situated on a vertical straight line (Franz [4]). A simple calculus by means of (73) shows, that the imaginary part of γ does not influence the convergence of the series of residues. The real part of γ is not greater than in the case of an incident homogenous wave.
Thus we see, that the series of residues converges also if $|\cos\gamma| > 1$. It is sufficient to restrict γ on the stripe:
$0 < \gamma_{real\,part} < \pi,\ -\infty < \gamma_{im\,pt} < +\infty$, because of the periodicity of the cosin-function. Watson series furnishes the analytic continuation of the development of the solution in the shady zone.

2.2.3. The Distortion of the Watson (creeping) Wave by Transversal Attenuation of the Incident Wave

2.2.3.1 The Distortion of the Creeping Wave if the Diffracting Obstable is an Infinitely Conducting Circular Cylinder

In [4] Franz has treated the cylindric diffraction problem by means of Watsons transformation. It is easy to extend his results to the case of an inhomogenous incident wave. The two cases of polarisation of an incident electromagnetic wave are equivalent to the two boundary value problems of scalar waves $u = 0$ and $\frac{\partial u}{\partial n} = 0$.
If the incident wave is transversally attenuated, the situation of the poles defining creeping waves is not influenced. We generalise the studies of Franz in [4] and these ones of Hönl-Maue-Westpfahl [3] .

Let ν_s be the value of the index of cylinder-functions giving rise to the residue (creeping wave) in (Fig.13,14). ν_s is situated on the line, starting from kr_0

(r_0 = radius of the cylinder) under an angle of $\pi/3$ V_{real} is somewhat greater than kr_0, V_{im} small. ($V_{impl.} \ll kr_0$, $V_i = O(kr_0)^{1/3}$) . Denotes φ the angle of the azimuth (Fig.15) the shadow is situated on the cylinder in $\pi/2 < \varphi < 3\pi/2$. The creeping wave is to be studied in the shadow zone alone. The incident wave may run in the -x-direction and be attenuated in the -y direction.

$$
\begin{aligned}
u &= e^{-j\omega t}\, e^{-jkx\cosh a + ky\sinh a} \\
&= e^{-j\omega t}\, e^{-jkr(\cos\varphi\cosh a + j\sin\varphi\sinh a)} \\
&= e^{-j\omega t}\, e^{-jkr\cos(\varphi - ja)}
\end{aligned}
\tag{84}
$$

Then [3] [4] the creeping wave is ([3] [4]) given by:

$$\frac{\cos V_s(\pi-\varphi)}{\sin V_s\pi}\, e^{-jV_s\pi/2} \tag{85}$$

if the incident wave is homogenous and

$$\frac{\cos V_s(\pi-\varphi+ja)}{\sin V_s\pi}\, e^{-jV_s\pi/2} \tag{86}$$

if the incident wave is inhomogenous.

We reflect on the difference between (86) and (85). Refering to Fig. 19 we wright: ([17] p. 118)

$$V_s = V_r + jV_i \tag{81}$$

where only we take the first V_s

$$V_r = kr_0 + \frac{1}{2}\sqrt[3]{kr_0}\left[\frac{9\pi}{4}\right]^{2/3}\cos\pi/3 \tag{88}$$

$$V_i = \frac{1}{2}\sqrt[3]{kr_0}\left[\frac{9\pi}{4}\right]^{2/3}\sin\pi/3 \tag{89}$$

If a = 0 (incident wave homogenous):

$$(90)\quad \frac{\cos \nu_s(\pi-\varphi)}{\sin \nu_s \pi}\, e^{-j\nu_s \pi/2} = -j\, \frac{e^{j\nu_s(\frac{3}{2}\pi-\varphi)} + e^{j\nu_s(\varphi-\pi/2)}}{1-e^{-2j\nu_s\pi}}$$

With (87) we have after some calculus:

$$(91)\quad \frac{e^{j\nu_r(\frac{3\pi}{2}-\varphi)}\, e^{-\nu_i(\frac{3}{2}\pi-\varphi)} + e^{j\nu_r(\varphi-\pi/2)}\, e^{-\nu_i(\varphi-\pi/2)}}{1-e^{-2j\nu_r\pi}\, e^{2\nu_i\pi}}$$

The first term in the numerator represents a wave going around the cylinder coming from $\varphi=\frac{3\pi}{2}$ in the sens of negative φ, the second term gives a wave coming from $\varphi=\pi/2$ going in the sens of positive φ around the cylinder. These waves are exponentially attenuated with $-\nu_i\varphi$.

If $a \neq 0$ we wish to see the distortion of (91): From (88) we see, that

$$(92)\quad \nu_r > kr_0 \qquad \text{and}$$

$$(93)\quad \nu_r - kr_0 = \frac{1}{2}\sqrt[3]{kr_0}\left[\frac{9\pi}{4}\right]^{3/2}\cos \pi/3$$

Instead of (91) we have for $a \neq 0$:

$$(94)\quad \frac{e^{j\nu_r(\frac{3}{2}\pi-\varphi)-j\nu_i a-\nu_r a-\nu_i(\frac{3}{2}\pi-\varphi)} + e^{j\nu_r(\frac{\pi}{2}-\varphi)+j\nu_i a+\nu_r a-\nu_i(\varphi-\pi/2)}}{1-e^{-2j\nu_r\pi+2\nu_i\pi}}$$

The wave going in the sense of negative φ is in comparision with (92)

a) displaced in phase by $e^{-j\nu_i a}$
b) multiplied in amplitude by $e^{-\nu_r a}$

ν_r is somewhat greater than kr_0,

$\frac{\nu_i}{kr_0}$ is small. (kr_0 is supposed to be a great quantity).

The creeping wave enters the shady zone with an amplitude which the incident wave nearly has on the limit of shadow.

An analogous affirmation is valid for the second wave surrounding the cylinder in the sens of increasing φ .

2.2.3.2 <u>The Distortion of the Creeping Wave in the Spherical Case</u>

In the chapter about the diffraction of the inhomogenous wave by the sphere we had treated the vector-problem. In what follows we intend to treat the scalar problem with the boundary condition $u = 0$ on the surface of the sphere. In the vector-problem the function $P_n^1(\cos\gamma)$ arised. The scalar problem involves $P_n^0(\cos\gamma)$. The irregularities are given by

(95) $$\cos\gamma = \pm 1 .$$

and we have to find their situation on the sphere for γ defined by

(96) $$\cos\gamma = \cos\vartheta\cosh a - j\sin\vartheta\sinh a\cos\varphi$$

That $\cos\gamma$ takes the value $\pm$ 1, the imaginary part has to disappear:

(97) $$\cos\varphi = 0 , \quad \varphi = \pm\frac{\pi}{2} , \text{ or } \varphi = \frac{3\pi}{2}$$

$$(\sinh a \neq 0 , \ \sin\vartheta \neq 0 \text{ because } \sin\vartheta = 0 \text{ involves } \cos\gamma = \cos\vartheta\cosh a > 1)$$

(98) $$\cos\vartheta = \frac{1}{\cosh a}$$

On the meridians

$$\varphi = \frac{\pi}{2} , \quad \varphi = \frac{3\pi}{2} , \text{ in } \cos\vartheta = \frac{1}{\cosh a}$$

we have an irregulary point of the function P_s .

In the illuminated zone there exists on the meridians $\varphi = \frac{\pi}{2}$, $\varphi = 3\pi/2$ the irregularity in $\vartheta = \cos^{-1} 1/\cosh a$; in the shady zone in $\vartheta = \pi - \cos^{-1} 1/\cosh a$, $\cos\vartheta = -1/\cosh a$.
Now $P_s^0(-\cos\gamma) = (-1)^s P_s(\cos\gamma)$. We are not interested in the constant coefficient $(-1)^s$.
From Watson [11] we take the asymptotic expression of $P_\nu(\cosh\zeta)$:

$$(99)\quad P_\nu(\cosh\zeta) \sim \frac{e^{-\zeta/2}}{(\nu\pi)^{1/2}(1-e^{-2\zeta})^{1/2}}\left\{e^{(\nu+\frac{1}{2})\zeta} + e^{\pm j\pi} e^{-(\nu+\frac{1}{2})\zeta}\right\}$$

Evidently:

$$(100)\quad \cosh\zeta = \cos\gamma \sim j\zeta = \pm\gamma$$

we write

$$(101)\quad \zeta = \xi + j\eta = \mp j\gamma \qquad \text{and}$$

$$(102)\quad \nu_s = \nu + 1/2$$

We define x, y by:

$$(103)\quad x + jy = \cosh\zeta = \cos\vartheta\cosh a - j\sin\vartheta\sinh a\cos\varphi$$

and we have to look for the relation between ξ,η and ϑ,φ on the surface of the sphere. We have

$$(104)\quad \cosh\zeta = \cosh(\xi + j\eta) = \cosh\xi\cos\eta + j\sinh\xi\sin\eta$$

and with (103)

$$(105)\quad \cos\vartheta\cosh a = x\,, \quad -\sin\vartheta\sinh a\cos\varphi = y$$

$$(106)\quad \cosh\xi\cos\eta = x\,, \quad \sinh\xi\sin\eta = y$$

(106) is to be resolved with respect to $\cos\eta$ and $\sinh\xi$ expressed by x,y. Then we can evaluate ξ, η as functions of ϑ, φ . The solution of this systems runs in a similar way as the solution of (42) (43) in 2.3.3.1. We find

(107) $$\cos^2\eta = \frac{1}{2}\left(1+x^2+y^2-\sqrt{(1+x^2+y^2)^2-4x^2}\right)$$

(108) $$\cosh^2\xi = \frac{1}{2}\left(1+x^2+y^2+\sqrt{(1+x^2+y^2)^2-4x^2}\right) = 1+\sinh^2\xi$$

It is easy to find x,y as functions of ϑ, φ, a , then $\cos^2\eta$ and $\cosh^2\xi$ are easily found by numerical calculus. We are looking for curves $\varphi = \text{const}, \vartheta = \text{const}$ for a given a in the ξ, η plane.

In the following numerical example we have chosen $a = 1$. The mapping of ϑ, φ -curves on the ξ, η plane runs as follows:

The mapping by means of $\cos, \cosh$ functions is well known. We restrict ourselves to the domain in ϑ and φ forming the shadow zone:

(109) $$\frac{\pi}{2} \le \vartheta \le \pi \qquad -\pi \le \varphi \le \pi$$

Then:

(110) $$\cos\vartheta \le 0, \quad \sin\vartheta \ge 0 \quad \text{and}$$

(111) $$\text{for} \begin{cases} -\pi < \varphi < -\frac{\pi}{2} & y > 0 \\ -\frac{\pi}{2} < \varphi < +\frac{\pi}{2} & y < 0 \\ \frac{\pi}{2} < \varphi < \pi & y > 0 \end{cases}$$

Tables for $\begin{matrix}\cos\\ \sin\end{matrix}\eta$ $\begin{matrix}\cosh\\ \sinh\end{matrix}\xi$ are published [15].

Curves $\xi = \text{const}, \eta = \text{const}$ in the x,y plane are easily found: from (105) (106) we have:

(112) $x = \cos\vartheta \cosh a\,, \quad y = \sin\vartheta \sinh a \cos\varphi$

(113) $\cos\vartheta = \dfrac{x}{\cosh a}\,, \quad \sin\vartheta = \dfrac{y}{\sinh a \cos\varphi}$

(114) $\dfrac{x^2}{\cosh^2 a} + \dfrac{y^2}{\sinh^2 a \cos^2\varphi} = 1$

For a fixed value of a, a meridian-cycle $\varphi = \text{const}$ is mapped in the x,y plane on an ellipse with the half-axis

(115) $\cosh a\,, \quad \sinh a \cdot |\cos\varphi|\,,$
$\quad$ for $\varphi = {0 \atop \pi}\,, \quad |\cos\varphi| = 1\,;$

the ellipses are enclosed in the ellipse

(116) $\dfrac{x^2}{\cosh^2 a} + \dfrac{y^2}{\sinh^2 a} = 1.$

In the x,y plane $x = \pm 1, y = 0$ are branche points (Fig. 16). The strightlines $y = 0, |x| > 1$ are cuts. The ξ, η plane is given in Fig. 17. Corresponding lines in Fig. 16 and Fig. 17 are drawn in the same manner (xxx ''''' --- and so on). In the ξ, η -plane we are interested in the domaines corresponding $\pi/2 < \vartheta < \pi$ $-\pi < \varphi < \pi$ Now $\vartheta = \pi$ is a pole of the sphere where all lines $\varphi = \text{const}$ converge. In the ξ, η plane this point appears as a stright line, $\vartheta = \pi$, $-\pi < \varphi < +\pi$ corresponds $-a \le \xi \le +a, \eta = -a$ The lower quadrant of the ellipse in Fig. 16 corresponds to $0 < \varphi < \pi/2, \frac{\pi}{2} < \vartheta < \pi$. $0 < x < -1$ is the transition line between the two quadrants; the upper one corresponds to $\frac{\pi}{2} < \vartheta < \pi, \frac{\pi}{2} < \varphi < \pi$. The domains $-\frac{\pi}{2} < \varphi < 0, \frac{\pi}{2} < \vartheta < \pi$ and $-\pi < \varphi < -\frac{\pi}{2}$

are situated in the lower sheets of the Riemannian surface. They are connected along the cut $x < -1$. Some curves corresponding to the ellipses $\varphi = const$ are evaluated numerically and we have drawn in the ξ, η plane some curves $\vartheta = const, \varphi = const$. The equations in the analytic form come from (105) (106). Curves $\vartheta = const$ are:

$$(117) \quad \cos\vartheta = \frac{\cosh\xi \cos\eta}{\cosh a} = const$$

curves $\varphi = const$ are

$$(118) \quad \frac{\cosh^2\xi \cos^2\eta}{\cosh^2 a} + \frac{\sinh^2\xi \sin^2\eta}{\sinh^2 a \cos^2\varphi} = 1$$

In Fig. 22 we have drawn evaluated curves ($a = 1$). The branch point is $\eta = -a, \xi = 0$.

Now we wish to see the residue representing the creeping wave in the case of an incident inhomogenous wave. According to Sommerfeld [17] p. 969 the residue for $a \to 0$ is:

$$(119) \quad u_{res} = \frac{P_{\nu_s - 1/2}(\cos(\pi - \vartheta))}{\cos \pi\nu_s} \qquad \text{where}$$

$\nu_s - \nu_{Pole}$ (given in (87) (88) (89)

By means of (99) we find:

$$(120) \quad u_{res} \sim \frac{1}{\sqrt{\sin\gamma}} \frac{\cos(\nu_s(\pi-\gamma) - \pi/4)}{\cos\nu_s\pi}$$

from what follows:

$$(121) \quad u_{res} \sim \frac{e^{j(\nu_{sr}+j\nu_{si})\pi - (\nu_{sr}+j\nu_{si})(\xi - j\eta)} + j e^{-j(\nu_{sr}+j\nu_{si})\pi + (\nu_{sr}+j\nu_{si})(\xi - j\eta)}}{\left(e^{(\xi+j\eta)} - e^{-(\xi+j\eta)}\right)^{1/2}\left(e^{j(\nu_{sr}+j\nu_{si})\pi} + e^{-j(\nu_{sr}+j\nu_{si})\pi}\right)}$$

($-j\eta$ is chosen that the field decreases with increasing ϑ, $\pi - \gamma$)

Certainly:

$$e^{-\nu_{si}\pi} \ll e^{+\nu_{si}\pi} \quad (kR_0 \text{ very great}) \tag{122}$$

and (121) is to be written in such a manner that for $a \to 0$ the values known from [17] become evident. Then we have

$$u \sim \frac{\exp\left[j\nu_{sr}\tau - \nu_{si}\tau - \nu_{sr}\xi - \nu_{si}\eta - j\nu_{si}\xi + j\nu_{sr}\eta - j\pi/2\right]}{\left(e^{(\xi+j\eta)} - e^{-(\xi+j\eta)}\right)^{1/2} e^{-j\nu_{sr}\tau}\, e^{+\nu_{si}\tau}}$$

$$+ \frac{\exp\left[-j\nu_{sr}\tau + \nu_{si}\tau + \nu_{sr}\xi + \nu_{si}\eta + j\nu_{si}\xi - j\nu_{sr}\eta + j\pi/2\right]}{\left(e^{(\xi+j\eta)} - e^{-(\xi+j\eta)}\right)^{1/2} e^{-j\nu_{sr}\tau - \nu_{si}\tau}} \tag{123}$$

Now for $\varphi = 0$ (see Fig.20)

$$e^{\pm \nu_{sr}\xi} \to e^{\pm \nu_{sr} R_0} \tag{124}$$

There exist beginning with $\vartheta = \pi/2$ attenuated waves entering the sehady zone in a similar way as in the cylindrical case; on $\vartheta = \pi/2$ the amplitude is somewhat greater than the value of the incident field because $\nu_{sr} > kR_0$. The field about the singularity and on the cuts may not be treated here.

2.3. The General Geometrical Optics of Transversally Attenuated Waves: Reflection and Transmissions of Such a Wave on Plane Surfaces of Any Dielectric Media with Arbitrary Angles of Incidence

2.3.1 Motivating of This Theory as a Limit in Diffraction Theory (Fig. 18)

As Franz [4] has shown in the Limit the diffraction problem on a smooth curved surface on the illuminated side is resolved by the sum of creeping waves, coming from the shady zone surrounding the body several time with exponential attenuation and the geometrical optics, i.e.

the reflection of the incident wave on the tangential plane of the body in every point. The incident wave in our theory is a transversally attenuated one. The limiting "ray" in our definition is a tangent on the limit between the illuminated and the shady zone. In the domain of the illuminated part the rays make every angle between 0 and $\pi/2$ with a tangent of the body or between $\pi/2$ and 0 with the normal of the body.

The solution of 2.1 , $2\partial F/\partial z$ is directly the solution of geometrical optics for an infinitely conducting body. However it seems to be of some interest to know the reflection and transmission-conditions on plane surfaces, representing a continuation of Fresnels theorie to complex angles. In appendix II we have explaned the generation of our type of wave by medium stratification, i.e. in the case of total reflection.

2.3.2 Reflection of a Transversally Attenuated Electric Wave by a Plane Surface of Another Medium, Situated Parallel to the wave Normales

The wave whose generation in the plane $y = 0$ (Fig. 19.20) is described in appendix II is now supposed as existing in $-\infty < y < y_1$ in a medium of ε_2 , i.e. the wave is continued into the space $y < 0$. i.e. we consider only med. 2 and 3, med. 1 is now supposed as not more existent, transition between 2 and 3 in $y = 0$. Let this wave be reflected by another medium whose surface is a plane y. This would represent the case of grazing incidence following our new definition of the direction of incidence. Formally it represents grazing incidence for $a = 0$, i.e. in the limiting case where our wave is still homogenous. For $a \neq 0$ we study this reflection for two conditions

a) in $y > y_1$ the wave is inhomogenous

b) in $y > y_1$ the wave is homogenous.

2.3.2.1 Reflection of a Transversally Attenuated i.e. Inhomogenous Wave by a Plane Surface Parallel to the Wave Normal when the Wave Transmitted[23] also Inhomogenous

For both polarisations we write down the incident wave ($y<y_1$).

(1)

$$E_{xi} = \exp[-jk_2 z\cosh v_2 - k_2 y \sinh v_2] \qquad H_{xi} = \exp[-jk_2 z\cosh v_2 - k_2 y \sinh v_2]$$

$$H_{yi} = -\frac{1}{Z^{(2)}}\cosh v_2 E_{xi} \qquad E_{yi} = Z^{(2)}\cosh v_2 H_{xi}$$

$$H_{zi} = -\frac{j}{Z^{(2)}}\sinh v_2 E_{xi} \qquad E_{zi} = jZ^{(2)}\sinh v_2 H_{xi}$$

It is evident that the y-component of Poyntings vector is imaginary. ($Z^{(2)}$ = Wave-Impedance of med. 2)

By inverting the signe of y in the exponent and joining the reflection coefficients r_e, r_h we get the refl. waves

(2)

$$E_{xr} = r_e\exp[-jk_2 z\cosh v_2 + k_2 y \sinh v_2] \qquad H_{xr} = r_h\exp[-jk_2 z\cosh v_2 + k_2 y \sinh v_2]$$

$$H_{yr} = -\frac{r_e}{Z^{(2)}}\cosh v_2 \exp[\quad] \qquad E_{yr} = -r_h Z^{(2)}\cosh v_2 \exp[\quad]$$

$$H_{zr} = -\frac{j r_e}{Z^{(2)}}\sinh v_2 \exp[\quad] \qquad E_{zr} = -j r_h Z^{(2)}\sinh v_2 \exp[\quad]$$

Now we write down the transmitted wave entering the third medium:

Transmitted wave:

$$E_{xt} = t_e \exp[-jk_3 z \cosh v_3 - k_3 y \sinh v_3] \qquad H_{xt} = t_h \exp[-jk_3 z \cosh v_3 - k_3 y \sinh v_3]$$

$$(3) \quad H_{yt} = -\frac{t_e}{Z^{(3)}} \cosh v_3 \exp[\quad] \qquad E_{yt} = t_h Z^{(3)} \cosh v_3 \exp[\quad]$$

$$H_{zt} = -\frac{jt_e}{Z^{(3)}} \sinh v_3 \exp[\quad] \qquad E_{zt} = jt_h Z^{(3)} \sinh v_3 \exp[\quad]$$

We wish to calculate the coefficients of transmission and reflection t_e, t_h, r_e, r_h between the two media 2 and 3. The transition conditions identically valuable in z are:

$$(4) \quad \begin{array}{l|l} E_{xt} = E_{xi} + E_{xr} & H_{xt} = H_{xi} + H_{xr} \\ H_{zt} = H_{zi} + H_{zr} & E_{zt} = E_{zi} + E_{zr} \end{array} \quad \text{in } y = y_0$$

The law of refraction due toe the identical valuability of (4) in z will be studied in some detail later on. In our present case it runs as follows:(see also App. II, eq. (11)(12) ÷ (20)

$$(5) \quad k_2 \cosh v_2 = k_3 \cosh v_3 , \quad \cosh v_3 = \frac{k_2}{k_3} \cosh v_2$$

If

$$(6) \quad \cosh v_3 \geq 1 \qquad k_3 \leq k_2 \cosh v_2$$

i.e. the transmitted wave is also inhomogenous, transversally attenuated, then:

$$(71) \quad \sinh v_3 = \sqrt{\left(\frac{k_2}{k_3} \cosh v_2\right)^2 - 1}$$

The transition conditions in $y = y_0$ are (the common factor $\exp[-jk_2 z \cosh v_2] = \exp[-jk_3 z \cosh v_3]$ is omitted:

$$t_e e^{-k_3 y_0 \sinh v_3} = e^{-k_2 y_0 \sinh v_2} + r_e e^{+k_2 y_0 \sinh v_2}$$

$$t_h e^{-k_3 y_0 \sinh v_3} = e^{-k_2 y_0 \sinh v_2} + r_h e^{+k_2 y_0 \sinh v_2}$$

(7)

$$-t_e j \frac{\sinh v_3}{Z^{(3)}} e^{-k_3 y_0 \sinh v_3} = -j \frac{\sinh v_2}{Z^{(2)}} e^{-k_2 y_0 \sinh v_2} + r_e j \frac{\sinh v_2}{Z^{(2)}} e^{+k_2 y_0 \sinh v_2}$$

$$t_h j Z^{(3)} \sinh v_3 e^{-k_3 y_0 \sinh v_2} = j Z^{(2)} \sinh v_2 e^{-k_2 y_0 \sinh v_2} - r_h j Z^{(2)} \sinh v_2 e^{+k_2 y_0 \sinh v_2}$$

the solution of these equations is:

$$(8)\quad t_e = \frac{2 \sinh v_2 / Z^{(2)}}{\exp[y_0(k_2 \sinh v_2 - k_3 \sinh v_3)]\left(\frac{\sinh v_2}{Z^{(2)}} + \frac{\sinh v_3}{Z^{(3)}}\right)}$$

$$(9)\quad r_e = \frac{\exp[-2k_2 y_0 \sinh v_2]\left(\frac{\sinh v_2}{Z^{(2)}} - \frac{\sinh v_3}{Z^{(3)}}\right)}{\left(\frac{\sinh v_2}{Z^{(2)}} + \frac{\sinh v_3}{Z^{(3)}}\right)}$$

$$(10)\quad t_h = \frac{2 Z^{(2)} \sinh v_2}{\exp[y_0(k_2 \sinh v_2 - k_3 \sinh v_3)]\left(Z^{(2)} \sinh v_2 + Z^{(3)} \sinh v_3\right)}$$

$$(11)\quad r_h = \frac{\exp[-2k_2 y_0 \sinh v_2]\left(Z^{(2)} \sinh v_2 - Z^{(3)} \sinh v_3\right)}{\left(Z^{(2)} \sinh v_2 + Z^{(3)} \sinh v_3\right)}$$

From these expressions we find:

If $v_2 = 0$ the transversal attenuation is 0, then our incident wave is a homogenous one, going in the -z-direction, a plane wave with grazing incidence: Then

$$(12)\quad r_e = r_h = -1$$

in accordance with the well known theory of homogenous waves.

A zero in r_e and r_h is given if and only if

$$\varepsilon_2 = \varepsilon_3 \qquad (12a)$$

This result turns out from a discussion of (8) (11) by expressing $Z^{(i)}, k_i, \cosh v_i, \sinh v_i$ by means of their defining equations.

2.3.2.2 The Reflection of The Incident Inhomogenous Wave if The Transmitted Wave is Homogenous

Let arise a homogenous wave for $y > y_0$ (see also App.II eq. (11) (20) and the discussion of the generalized law of refraction later on) consequently

$$k_3 > k_2 \cosh v_2 \sim k_3 \cos\vartheta_3 = k_2 \cosh v_2 \qquad (13)$$

The mathematical expressions for the incident and the reflected waves are again (1) (2), the transmitted wave is now:

$$\begin{array}{l|l} E_{xt} = t_e \exp[-jk_3 z\cos\vartheta_3 + jk_3 y\sin\vartheta_3] & H_{xt} = t_h \exp[-jk_3 z\cos\vartheta_3 + jk_3 y\sin\vartheta_3] \\ H_{yt} = -\dfrac{t_e}{Z^{(3)}}\cos\vartheta_3 \exp[\quad] & E_{yt} = t_h Z^{(3)}\cos\vartheta_3 \exp[\quad] \\ H_{zt} = -\dfrac{t_e}{Z^{(3)}}\sin\vartheta_3 \exp[\quad] & E_{xt} = t_h Z^{(3)}\sin\vartheta_3 \exp[\quad] \end{array} \qquad (14)$$

The boundary conditions are also given by (4). Then we find by a trivial calculus:

$$t_e = \frac{2j\sinh v_2 / Z^{(2)}}{\exp[jk_3 y_0 \sin\vartheta_3 + k_2 y_0 \sinh v_2]\left(j\dfrac{\sinh v_2}{Z^{(2)}} + \dfrac{\sin\vartheta_3}{Z^{(3)}}\right)} \qquad (15)$$

$$(16)\quad r_e = \frac{\exp[-2k_2 y_0 \sinh v_2]\left(j \sinh v_2/Z^{(2)} - \sin\vartheta_3/Z^{(3)}\right)}{\left(j \dfrac{\sinh v_2}{Z^{(2)}} + \dfrac{\sin\vartheta_3}{Z^{(3)}}\right)}$$

$$(17)\quad t_h = \frac{2j Z^{(2)} \sinh v_2}{\exp[j k_3 y_0 \sin\vartheta_3 + k_2 y_0 \sinh v_2]\left(j Z^{(2)} \sinh v_2 + Z^{(3)} \sin\vartheta_3\right)}$$

$$(18)\quad r_h = \frac{\exp[-2k_2 y_0 \sinh v_2]\left[j Z^{(2)} \sinh v_2 - Z^{(3)} \sin\vartheta_3\right]}{\left[j Z^{(2)} \sinh v_2 + Z^{(3)} \sin\vartheta_3\right]}$$

2.3.2.3 <u>The Field of Poynting Vectors in The Media 2 and 3</u>

We wish to know the field of Poynting vectors in the neighbourhood of the plane separating the media 2 and 3 in the following cases

1) there is no reflection, 3rd medium identical with the second one and
2) reflection in such a manner, that in the third medium a homogenous wave is transmitted.

1) We have seen in (1) (2) for both polarisations, that the components of $\vec{E}$ and $\vec{H}$ lying in the xz-plane are out of phase by an angle $\pi/2$; the y-component of Poynting vector is imaginary and in the y-direction no energy is transmitted in the mean.

2) If in the third medium the wave becomes homogenous, the phase-shifting is distorted. We restrict ourselves to the case E_x, H_y, H_z . Let arrive in $y_0 = 0$ an inhomogenous wave being reflected in $y_0 = 0$, let be transmitted a homogenous wave and we are looking for the y-component of Poyntings vector. (Now transition in $y_0 = 0$, being incident the inhomogenous wave continued to $y < 0$). With (1) (2) (14) (15) (16) we get:

$$E_x = \exp[-j k_2 z \cosh v_2 - k_2 y \sinh v_2]$$
$$(19)\quad + \frac{j Z^{(3)} \sinh v_2 - Z^{(2)} \sin\vartheta_3}{j Z^{(3)} \sinh v_2 + Z^{(2)} \sin\vartheta_3} \exp[-j k_2 z \cosh v_2 + k_2 y \sinh v_2]$$

$$H_z = -j\frac{\sinh v_2}{Z^{(2)}}\exp\left[-jk_2 z\cosh v_2 + k_2 y\sinh v_2\right]$$

$$(20)\quad +j\frac{\sinh v_2}{Z^{(2)}}\,\frac{jZ^{(3)}\sinh v_2 - Z^{(2)}\sin\vartheta_3}{jZ^{(3)}\sinh v_2 + Z^{(2)}\sin\vartheta_3}\times$$
$$\times\exp\left[-jk_2 z\cosh v_2 + k_2 y\sinh v_2\right]$$

for $y < 0$ in the med. ε_2

Here we put:

$$(21)\quad \frac{Z^{(2)}\sin\vartheta_3 - jZ^{(3)}\sinh v_2}{Z^{(2)}\sin\vartheta_3 + jZ^{(3)}\sinh v_2} = e^{-2j\varphi_1} \text{ with}$$

$$(22)\quad \varphi_1 = tg^{-1}\frac{Z^{(3)}\sinh v_2}{Z^{(2)}\sin\vartheta_3}$$

(quotient of two conj.compl. numbers)

and we take into account, that $\varphi_1 = \pi/2$ is only possible if $\vartheta_3 = 0$ or $\sinh v_2 \to \infty$; $\varphi_1 = 0$ is only possible for $v_2 = 0$

With exception of these cases following (19) (20)

$$(23)\quad \frac{E_x}{H_z} = \frac{jZ^{(2)}}{\sinh v_2}\,\frac{e^{-2k_2 y\sinh v_2} - e^{-2j\varphi_1}}{e^{-2k_2 y\sinh v_2} + e^{-2j\varphi_1}} \qquad y<0,\ (\text{Fig }21)$$

is certainly not imaginary, so that a real component of Poyntings vector arises. In Fig. 21 the vectors $\mathfrak{E}$ and $\mathfrak{H}$ are not in phase. The wave transmitted into $y > y_0$ gets its energy in this manner.

2.3.3 Reflection of Transversally Attenuated Waves if the Angle of Incidence is Anyone

We remember that the direction of incidence in our treatise is given by the direction of the wave normales

or of the real part of Pyntings vector. The plane, on which the reflection arises was parallel to this vector, normal to y , parallel to the plane x, z. Now we rotate the normale of the separating plane and this plane itself by an angle β . The x -axis is taken as the axis of this rotation and is conserved. (Fig. 22)
The transformation of coordinates is effectuated in the y-z-plane from y,z coordinates to $\xi\ \eta$ coordinates:

$$
(24)\quad \begin{aligned} y &= \eta\cos\beta + \xi\sin\beta \\ z &= -\eta\sin\beta + \xi\cos\beta \end{aligned}
$$

$$
(25)\quad \begin{aligned} \eta &= y\cos\beta - z\sin\beta \\ \xi &= y\sin\beta + z\cos\beta \end{aligned}
$$

Because x is not influenced by this transformation E_x and H_x of the incident wave are to be retained and the transformations concerns only H_y, H_z or E_y, E_z resp.

Now Maxwells equations are invariant against rotations of the system of coordinates.

Then we have: Incident wave

$$
(26)\quad \begin{aligned} E_x \text{ resp } H_x &= \exp\left[-jk_2 z\cosh v_2 - k_2 y \sinh v_2\right] \\ &= \exp\left[-jk_2\xi\cos(\beta+jv_2) + jk_2\eta\sin(\beta+jv_2)\right] \end{aligned}
$$

after a simple calculus by means of (24) (25). We see, that as in the real case β is directly added to the existing angle of incidence jv_2 being complex.

From Maxwells equations in x, η, ξ it follows immediately for the both cases of polarisation:

$$
(27)\quad \begin{aligned} H_\eta &= \frac{1}{j\omega\mu_0\mu}\frac{\partial E_x}{\partial\xi} \qquad & E_\eta &= -\frac{1}{j\omega\varepsilon_0\varepsilon}\frac{\partial H_x}{\partial\xi} \\ H_\xi &= -\frac{1}{j\omega\mu_0\mu}\frac{\partial E_x}{\partial\eta} \qquad & E_z &= \frac{1}{j\omega\varepsilon_0\varepsilon}\frac{\partial H_x}{\partial\eta} \end{aligned}
$$

This furnishes with (1) (2) (26)

(28)

$$H_\eta = -\frac{1}{Z^{(2)}}\cos(\beta+j\nu_2)\times \exp\left[-jk_2\zeta\cos(\beta+j\nu_2) + jk_2\eta\sin(\beta+j\nu_2)\right] \quad \Big| \quad E_\eta = Z^{(2)}\cos(\beta+j\nu_2)\times \exp\left[-jk_2\zeta\cos(\beta+j\nu_2) + jk_2\eta\sin(\beta+j\nu_2)\right]$$

$$H_\zeta = -\frac{1}{Z^{(2)}}\sin(\beta+j\nu_2)\times \exp[\quad] \quad \Big| \quad E_\zeta = Z^{(2)}\sin(\beta+j\nu_2)\exp[\quad]$$

Writing down the reflected wave we are anticipating the law that angle of incidence = angle of reflection, verified automatically by analytic continuation from the Fresnels real case.

(29)

$$E_{xr} = r_e\exp\left[-jk_2\zeta\cos(\beta+j\nu_2) - jk_2\eta\sin(\beta+j\nu_2)\right] \quad \Big| \quad H_{xr} = r_h\exp\left[-jk_2\zeta\cos(\beta+j\nu_2) - jk_2\eta\sin(\beta+j\nu_2)\right]$$

$$H_{\eta r} = -\frac{r_e}{Z^{(2)}}\cos(\beta+j\nu_2)\exp[\quad] \quad \Big| \quad E_{\eta r} = r_h Z^{(2)}\cos(\beta+j\nu_2)\exp[\quad]$$

$$H_{\zeta r} = \frac{r_e}{Z^{(2)}}\sin(\beta+j\nu_2)\exp[\quad] \quad \Big| \quad E_{\zeta r} = -r_h Z^{(2)}\sin(\beta+j\nu_2)\exp[\quad]$$

The transmitted wave is

(30)

$$E_{xt} = t_e\exp\left[-jk_3\zeta\cos(\gamma+j\nu_3) + jk_3\eta\sin(\gamma+j\nu_3)\right] \quad \Big| \quad H_{xt} = t_h\exp\left[-jk_3\zeta\cos(\gamma+j\nu_3) + jk_3\eta\sin(\gamma+j\nu_3)\right]$$

$$H_{\eta t} = -\frac{t_e}{Z^{(3)}}\cos(\gamma+j\nu_3)\exp[\quad] \quad \Big| \quad E_{\eta t} = t_h Z^{(3)}\cos(\gamma+j\nu_3)\exp[\quad]$$

$$H_{\zeta t} = -\frac{t_e}{Z^{(3)}}\sin(\gamma+j\nu_3)\exp[\quad] \quad \Big| \quad E_{\zeta t} = t_h Z^{(3)}\sin(\gamma+j\nu_3)\exp[\quad]$$

(γ = angle corresp. β in the med. 3)

The boundary conditions to be fullfilled are (identically in ζ)

$$
(31)\quad
\begin{array}{l|l}
a)\; E_{xi} + E_{xr} = E_{xt} & c)\; H_{xi} + H_{xr} = H_{xt} \\
b)\; H_{\zeta i} + H_{\zeta r} = H_{\zeta t} & d)\; E_{\zeta i} + E_{\zeta r} = E_{\zeta t}
\end{array}
$$

These equations are the following ones, if they are written explicitely:

$$a)\; \exp[-jk_2\zeta\cos(\beta+j\nu_2)] + r_e\exp[-jk_2\zeta\cos(\beta+j\nu_2)] = t_e\exp[-jk_3\zeta\cos(\gamma+j\nu_3)]$$

$$b)\; -\frac{\sin(\beta+j\nu_2)}{Z^{(2)}}\exp[-jk_2\zeta\cos(\beta+j\nu_2)] + r_e\frac{\sin(\beta+j\nu_2)}{Z^{(2)}}\exp[-jk_2\zeta\cos(\beta+j\nu_2)]$$
$$= -t_e\frac{\sin(\gamma+j\nu_3)}{Z^{(3)}}\exp[-jk_3\zeta\cos(\gamma+j\nu_3)]$$

(32)

$$c)\; \exp[-jk_2\zeta\cos(\beta+j\nu_2)] + r_h\exp[-jk_2\zeta\cos(\beta+j\nu_2)] = t_h\exp[-jk_3\zeta\cos(\gamma+j\nu_3)]$$

$$d)\; Z^{(2)}\sin(\beta+j\nu_2)\exp[-jk_2\zeta\cos(\beta+j\nu_2)] - r_h Z^{(2)}\sin(\beta+j\nu_2)\exp[-jk_2\zeta\cos(\beta+j\nu_2)]$$
$$= t_h Z^{(3)}\sin(\gamma+j\nu_3)\exp[-jk_3\zeta\cos(\gamma+j\nu_3)]$$

2.3.3.1 <u>The Generalized Law of Refration.</u>

For fullfilling (31) (32) identically in ζ the exponential factors must be the sames on the left and the right hand of eq. (32) (33). This leads us automatically to an analytic continuation of Snell's law of refraction in the domain of complex angles of direction and it seems to be worth while to study this law. Thus we have

$$(33)\quad k_2\cos(\beta+j\nu_2) = k_3\cos(\gamma+j\nu_3)$$

We write (33) in the form:

$$(34)\quad k_2(\cos\beta\cosh v_2 - j\sin\beta\sinh v_2) = k_3(\cos\gamma\cosh v_3 - j\sin\gamma\sinh v_3) \quad \text{or}$$

$$(35)\quad k_2\cos\beta\cosh v_2 = k_3\cos\gamma\cosh v_3$$

$$(36)\quad k_2\sin\beta\sinh v_2 = k_3\sin\gamma\sinh v_3$$

These equations are to be resolved with resp. to γ, v_3 if β and v_2 are given. We wish to do it in a manner being clear from a physical point of view. The equations contain the well known law of Snellins if v_2 and v_3 are zero: then

$$(37)\quad k_2\cos\beta = k_3\cos\gamma$$

the normal case, valuable as long as this equation is fullfilled by real values of β and γ. But if $k_3 < k_2$ so that $\cos\gamma > 1$ a solution with real values of γ is not more possible and we have to take the general form (35) (36).

If a homogenous wave is incident (β real, $v_2 = 0$) we find in this case:

$$(38)\quad k_2\cos\beta = k_3\cos\gamma\cosh v_3$$

$$(39)\quad 0 = k_3\sin\gamma\sinh v_3$$

As v_3 cannot disappear ($k_2\cos\beta = k_3\cos\gamma$ is not possible with real γ) we have:

$$(40)\quad \sin\gamma = 0 \qquad \text{and}$$

$$(41)\quad \cosh v_3 = \frac{k_2}{k_3}\cos\beta > 1$$

This is the normal case of total reflection. Now we turn ourselves to the question: what will happen, if $v_2 \neq 0$
For a given β we have to find γ and v_3 : instead of (35) (36) we write:

$$(42)\quad \cos\gamma \cosh v_3 = \frac{k_2}{k_3} \cos\beta \cosh v_2$$

$$(43)\quad \sin\gamma \sinh v_3 = \frac{k_2}{k_3} \sin\beta \sinh v_2$$

With

$$(44)\quad \frac{k_2}{k_3} \cos\beta \cosh v_2 \overset{def}{=} A > 0, \quad \frac{k_2}{k_3} \sin\beta \sinh v_2 \overset{def}{=} B > 0$$

we get:

$$(45)\quad \cos^2\gamma \cosh^2 v_3 + \sin^2\gamma \sinh^2 v_3 = A^2 + B^2$$

$$(46)\quad \cos^2\gamma \cosh^2 v_3 - \sin^2\gamma \sinh^2 v_3 = A^2 - B^2$$

From the well known relations

$$(47)\quad \cosh^2 v - \sinh^2 v = 1, \quad \cos^2\gamma + \sin^2\gamma = 1$$

and (45) (46) we see:

$$(48)\quad \cos^2\gamma + \cosh^2 v_3 = 1 + A^2 + B^2$$

$$(49)\quad \cos^2\gamma\,(2\cosh^2 v_3 - 1) - \cosh^2 v_3 = A^2 - B^2 - 1$$

We write these equations in such a manner that the numbers $\cos\gamma \leq 1$ and $\cosh v_3 \geq 1$ arise as unknown quantities. This will simplify the discussion later on.
Choosing the symbols

$$(50)\quad \cos^2\gamma \overset{def}{=} \xi, \quad \cosh^2 v_3 \overset{def}{=} \eta$$

we have to notice that the solutions of (48) (49) are always positive; we have then:

(51) $$\xi + \eta = A^2 + B^2 + 1$$

(52) $$2\xi\eta - (\xi + \eta) = A^2 - B^2 - 1$$

Putting

(53) $$A^2 + B^2 + 1 \overset{\text{def}}{=} \alpha, \quad A^2 - B^2 - 1 \overset{\text{def}}{=} \beta,$$
$$\alpha + \beta \overset{\text{def}}{=} \delta = 2A^2$$

we have

(54) $$\xi + \eta = \alpha$$

(55) $$2\xi\eta = \delta$$ consequently

(56) $$(\xi + \eta)^2 = \alpha^2$$

(57) $$(\xi - \eta)^2 = \alpha^2 - 2\delta$$

and

(58) $$\xi - \eta = -\left|\sqrt{\alpha^2 - 2\delta}\right|$$

i.e. the neg. root because $\eta > \xi$ (50)
Then we have:

(59) $$\xi = \tfrac{1}{2}\left(\alpha - \left|\sqrt{(\alpha^2 - 2\delta)}\right|\right) > 0$$

(60) $$\eta = \tfrac{1}{2}\left(\alpha + \left|\sqrt{(\alpha^2 - 2\delta)}\right|\right) > 0$$

It is easy to see, that $\alpha^2 - 2\delta > 0$, the solutions of (42) (43) are now:

$$(61)\quad \cos^2\gamma = \frac{1}{2}\left(A^2+B^2+1-\sqrt{(A^2+B^2+1)^2-4A^2}\right)$$

$$(62)\quad \cosh^2 v_3 = \frac{1}{2}\left(A^2+B^2+1+\sqrt{(A^2+B^2+1)^2-4A^2}\right)$$

Explicitely written, these solutions are:

$$\begin{matrix}\cos^2\gamma\\ \cosh^2 v_3\end{matrix} = \frac{1}{2}\Bigg(\left(\frac{k_2}{k_3}\right)^2\cos^2\beta\cosh^2 v_2+\left(\frac{k_2}{k_3}\right)^2\sin^2\beta\sinh^2 v_2+1$$

$$(63)\quad \mp\sqrt{\begin{matrix}\left[\left(\frac{k_2}{k_3}\right)^2\cos^2\beta\cosh^2 v_2\right]^2+\left[\left(\frac{k_2}{k_3}\right)^2\sin^2\beta\sinh^2 v_2\right]^2+1+2\left(\frac{k_2}{k_3}\right)^2\sin^2\beta\sinh^2 v_2\\ -2\left(\frac{k_2}{k_3}\right)^2\cos^2\beta\cosh^2 v_2+2\left(\frac{k_2}{k_3}\right)^4\cos^2\beta\sin^2\beta\cosh^2 v_2\sinh^2 v_2\end{matrix}}\Bigg)$$

Where $-$ corresponds to $\cos^2\gamma$

$+$ corresponds to $\cosh^2 v_3$

Thus we have derived the general relation between β, v_2 and γ, v_3. For controlling we put $v_2 = 0$

Then it is evident that:

$$(64)\quad \cos^2\gamma = 1\ ,\ \cosh^2 v_3 = \left(\frac{k_2}{k_3}\right)^2\cos^2\beta$$

That is to say that we have treated the case:

$$(65)\quad \left(\frac{k_2}{k_3}\right)^2 > \frac{1}{\cos^2\beta}\ ,\ \text{see eq. } (38) \div (41)$$

If in (63) we put $\cosh^2 v_3 = 1$, we have after some calculus:

$$(66)\quad \sin\beta\sinh v_2 = 0 \qquad \text{i.e.}$$

(67) either $\sin\beta = 0$ with (65)
or $\sinh v_2 = 0$

The result is:

If in the medium 2 the incident wave is inhomogenous, if for $\beta = 0$ in the medium 3 the wave is inhomogenous, the wave in medium 3 cannot become homogenous by variation of β, i.e. by variation of the direction of incidence.

This is the result of an analytic continuation of Snell's law into the domain of complex angles.

2.3.3.2 The Calculus of the Coefficients of Reflection and Transmission

By fullfilling the law of refraction in equation (31) (32) the exponential factors cancel out and a simple calculus furnishes:

$$(68)\quad r_e = \frac{Z^{(3)}\sin(\beta+jv_2) - Z^{(2)}\sin(\gamma+jv_3)}{Z^{(3)}\sin(\beta+jv_2) + Z^{(2)}\sin(\gamma+jv_3)}$$

$$(69)\quad t_e = \frac{2Z^{(3)}\sin(\beta+jv_2)}{Z^{(3)}\sin(\beta+jv_2) + Z^{(2)}\sin(\gamma+jv_3)}$$

$$(70)\quad r_h = \frac{Z^{(2)}\sin(\beta+jv_2) - Z^{(3)}\sin(\gamma+jv_3)}{Z^{(2)}\sin(\beta+jv_2) + Z^{(3)}\sin(\gamma+jv_3)}$$

$$(71)\quad t_h = \frac{2Z^{(2)}\sin(\beta+jv_2)}{Z^{(2)}\sin(\beta+jv_2) + Z^{(3)}\sin(\gamma+jv_3)}$$

This represents directly the analytic continuation of

Fresnel's laws into the domain of complex angles; if the plane of reflection is rotated by some angle ß, ß and γ arise as to be added to the imaginary angles v_2 and v_3 .

Reflection by an infintely conducting plane furnishes:

(72) $r_e = -1 \qquad t_e = 0$.

(73) $r_h = +1 \qquad t_h = 0$.

Supplement

The Reaction of a Third Layer upon the Total Reflection between Two Media (Fig. 23)

We shall treat the following problem:

Let exist three layers of dielectric material: The lowest one with $\varepsilon = \varepsilon_1$, the second one with $\varepsilon = \varepsilon_2 < \varepsilon_1$ the upper one with $\varepsilon = \varepsilon_3 = \varepsilon_1$. The separating plane between ε_1, and ε_2 may be placed in z=0, the plane between ε_2 and ε_3 in z=h.

Let exist in the medium 1 an incident electromagnetic wave with $E = E_x$ perpendicular the plane zy, the plane of incidence. (E_x, H_y, H_z). Let be chosen $\exp[-j\omega t]$ as a time function. γ_1 the angle of incidence may have a value such, that in absence of medium 3 total reflection arises. Now we wish to calculate the resultant reflection in the plane z=0 and we shall see that the total reflection is destroyed by the third medium.

The effect, that in this case in the third layer a homogenous wave is entering, is well known indeed, but until now, the author has never found a thorough treatment in the litterature and it seems to be worth-while to give it in the scope of this report as a supplement.

For writing the formulas we shall use the following symbols:

with ε_i (i = 1,2,3) we have the wave numbers

$$(1) \quad k_i = \omega\sqrt{\varepsilon_0\varepsilon_i\mu_0\mu_i} \qquad \mu_i = 1$$

$$(2) \quad k_i \sin\gamma_i = c_1^{(i)} \qquad k_i\cos\gamma_i = c_2^{(i)}, \quad i = 1,2,3$$

γ_i = angle of incidence in the medium i.

$$(3) \quad Z^{(i)} = \sqrt{\frac{\mu_0\mu_i}{\varepsilon_0\varepsilon_i}} = \sqrt{\frac{\mu_0}{\varepsilon_0\varepsilon_i}}$$

wave impedance of medium i

Then in the medium 1 we have an incident and a reflected wave, in the medium 2 a transmitted and a reflected wave, in the medium 3 a transmitted wave only.
$r^{(1)}, t^{(2)}, r^{(2)}, t^{(3)}$ are the coefficients of reflection and transmission in the medium 1,2,3 respectively. Let be 1 the amplitude of the incident E_x in the medium 1. Now we have in the first medium this incident wave:

$$E_{xi}^{(1)} = \exp\left[j c_2^{(1)} z + j c_1^{(1)} y\right] \tag{4}$$

$$H_{yi}^{(1)} = \frac{\cos\gamma_1}{Z^{(1)}} \exp\left[j c_2^{(1)} z + j c_1^{(1)} y\right] \tag{5}$$

$$H_{zi}^{(1)} = -\frac{\sin\gamma_1}{Z^{(1)}} \exp\left[j c_2^{(1)} z + j c_1^{(1)} y\right] \tag{6}$$

The wave reflected into the first medium is:

$$E_{xr}^{(1)} = r^{(1)} \exp\left[-j c_2^{(1)} z + j c_1^{(1)} y\right] \tag{7}$$

$$H_{yr}^{(1)} = -\frac{r^{(1)}\cos\gamma_1}{Z^{(1)}} \exp\left[-j c_2^{(1)} z + j c_1^{(1)} y\right] \tag{8}$$

$$H_{zr}^{(1)} = -\frac{r^{(1)}\sin\gamma_1}{Z^{(1)}} \exp\left[-j c_2^{(1)} z + j c_1^{(1)} y\right] \tag{9}$$

Here we have already used the well known law, that the angle of incidence is equal to the reflection angle.

In the second medium we have the transmitted wave

$$E_{xt}^{(2)} = t^{(2)} \exp\left[j c_2^{(2)} z + j c_1^{(2)} y\right] \tag{10}$$

$$(11)\quad H_{yt}^{(2)} = \frac{t^{(2)}\cos\gamma_2}{Z^{(2)}} \exp\left[j c_2^{(2)} z + j c_1^{(2)} y\right]$$

$$(12)\quad H_{zt}^{(2)} = -\frac{t^{(2)}\sin\gamma_2}{Z^{(2)}} \exp\left[j c_2^{(2)} z + j c_1^{(2)} y\right]$$

and the reflected wave:

$$(13)\quad E_{xr}^{(2)} = r^{(2)} \exp\left[-j c_2^{(2)} z + j c_1^{(2)} y\right]$$

$$(14)\quad H_{yr}^{(2)} = -\frac{r^{(2)}\cos\gamma_2}{Z^{(2)}} \exp\left[-j c_2^{(2)} z + j c_1^{(2)} y\right]$$

$$(15)\quad H_{zr}^{(2)} = -\frac{r^{(2)}\sin\gamma_2}{Z^{(2)}} \exp\left[-j c_2^{(2)} z + j c_1^{(2)} y\right]$$

In the third medium we have only a transmitted wave:

$$(16)\quad E_{xt}^{(3)} = t^{(3)} \exp\left[j c_2^{(3)} z + j c_1^{(3)} y\right]$$

$$(17)\quad H_{yt}^{(3)} = \frac{t^{(3)}\cos\gamma_3}{Z^{(3)}} \exp\left[j c_2^{(3)} z + j c_1^{(3)} y\right]$$

$$(18)\quad H_{zt}^{(3)} = -\frac{t^{(3)}\sin\gamma_3}{Z^{(3)}} \exp\left[j c_2^{(3)} z + j c_1^{(3)} y\right]$$

The transition-conditions are z=0: transition betwean medium 1 and 2

$$\left.\begin{aligned} &(19)\quad E_{xi}^{(1)} + E_{xr}^{(1)} = E_{xt}^{(2)} + E_{xr}^{(2)} \\ &(20)\quad H_{yt}^{(1)} + H_{yr}^{(1)} = H_{yt}^{(2)} + H_{yr}^{(2)} \end{aligned}\right\} z=0$$

$z = h$: transition between medium 2 and 3

$$\left.\begin{array}{ll} (21) & E_{xt}^{(2)} + E_{xr}^{(2)} = E_{xt}^{(3)} \\ (22) & H_{yt}^{(2)} + H_{yr}^{(2)} = H_{yt}^{(3)} \end{array}\right\} z = h$$

These conditions are valid identically in the variables x and y, from what follows the refraction law:

$$(23) \quad c_1^{(1)} = c_1^{(2)} = c_1^{(3)} \qquad \text{Since:}$$

$$(24) \quad c_1^{i} = k_i \sin \gamma_i$$

in the case of total reflection we have:

(25) $\sin \gamma_2 > 1$ that is to say γ_2 is complex

We had also supposed

$$(26) \quad \varepsilon_3 = \varepsilon_1 \ , \quad k_3 = k_1$$

We leave the case $k_3 > k_1$ to the reader.
Than we have:

$$(27) \quad c_1^{(3)} = k_3 \sin \gamma_3 = k_1 \sin \gamma_1 = c_1^{(1)}, \quad \sin \gamma_3 = \sin \gamma_1$$

Thus we find

$$(28) \quad c_2^{(1)} = k_1 \cos \gamma_1 = c_2^{(3)} = k_3 \cos \gamma_3 \ , \quad \cos \gamma_3 = \cos \gamma_1$$

The equations (19) (20) (21) (22) are to be written in the form:

$$\left.\begin{array}{ll} (29) & 1 + r^{(1)} = t^{(2)} + r^{(2)} \\ (30) & \dfrac{\cos \gamma_1}{Z^{(1)}} - r^{(1)} \dfrac{\cos \gamma_1}{Z^{(1)}} = t^{(2)} \dfrac{\cos \gamma_2}{Z^{(2)}} - r^{(2)} \dfrac{\cos \gamma_2}{Z^{(2)}} \end{array}\right\} z = 0$$

In $z = h$ we have:

(31) $$t^{(2)} \exp[j c_2^{(2)} h] + r^{(2)} \exp[-j c_2^{(2)} h] = t^{(3)} \exp[j c_2^{(3)} h]$$

(32) $$t^{(2)} \frac{\cos\gamma_2}{Z^{(2)}} \exp[j c_2^{(2)} h] - r^{(2)} \frac{\cos\gamma_2}{Z^{(2)}} \exp[-j c_2^{(2)} h] = t^{(3)} \frac{\cos\gamma_3}{Z^{(3)}} \exp[j c_2^{(3)} h]$$

from what follow the values of $r^{(1)}, t^{(2)}, r^{(2)}, t^{(3)}$:

(33) $$t^{(3)} = \frac{4 \cos\gamma_1 \cos\gamma_2 \cdot \left(1/Z^{(1)} Z^{(2)}\right)}{\left\{ \begin{array}{l} \exp[j(c_2^{(3)} - c_2^{(2)})h]\left(\frac{\cos\gamma_1}{Z^{(1)}} + \frac{\cos\gamma_2}{Z^{(2)}}\right)\left(\frac{\cos\gamma_2}{Z^{(2)}} + \frac{\cos\gamma_3}{Z^{(3)}}\right) \\ + \exp[j(c_2^{(3)} + c_2^{(2)})h]\left(\frac{\cos\gamma_2}{Z^{(2)}} - \frac{\cos\gamma_1}{Z^{(1)}}\right)\left(\frac{\cos\gamma_3}{Z^{(3)}} - \frac{\cos\gamma_2}{Z^{(2)}}\right) \end{array} \right\}}$$

(34) $$t^{(2)} = \frac{2 \frac{\cos\gamma_1}{Z^{(1)}}\left(\frac{\cos\gamma_2}{Z^{(2)}} + \frac{\cos\gamma_3}{Z^{(3)}}\right) \exp[j(c_2^{(3)} - c_2^{(2)})h]}{\left\{ \begin{array}{l} \exp[j(c_2^{(3)} - c_2^{(2)})h]\left(\frac{\cos\gamma_1}{Z^{(1)}} + \frac{\cos\gamma_2}{Z^{(2)}}\right)\left(\frac{\cos\gamma_2}{Z^{(2)}} + \frac{\cos\gamma_3}{Z^{(3)}}\right) \\ + \exp[j(c_2^{(3)} + c_2^{(2)})h]\left(\frac{\cos\gamma_2}{Z^{(2)}} - \frac{\cos\gamma_1}{Z^{(1)}}\right)\left(\frac{\cos\gamma_3}{Z^{(3)}} - \frac{\cos\gamma_2}{Z^{(2)}}\right) \end{array} \right\}}$$

(35) $$r^{(2)} = \frac{2 \exp[j(c_2^{(3)} + c_2^{(2)})h] \frac{\cos\gamma_1}{Z^{(1)}}\left(\frac{\cos\gamma_2}{Z^{(2)}} - \frac{\cos\gamma_3}{Z^{(3)}}\right)}{\left\{ \begin{array}{l} \exp[j(c_2^{(3)} - c_2^{(2)})h]\left(\frac{\cos\gamma_1}{Z^{(1)}} + \frac{\cos\gamma_2}{Z^{(2)}}\right)\left(\frac{\cos\gamma_2}{Z^{(2)}} + \frac{\cos\gamma_3}{Z^{(3)}}\right) \\ + \exp[j(c_2^{(3)} + c_2^{(2)})h]\left(\frac{\cos\gamma_2}{Z^{(2)}} - \frac{\cos\gamma_1}{Z^{(1)}}\right)\left(\frac{\cos\gamma_3}{Z^{(3)}} - \frac{\cos\gamma_2}{Z^{(2)}}\right) \end{array} \right\}}$$

(36) $$r^{(1)} = \frac{A_1 - B_1}{A_2 + B_2}$$

where

$$(37)\quad A_1 = \exp\left[j(c_2^{(2)} - c_2^{(1)})h\right]\left(\frac{\cos\gamma_1}{Z^{(1)}} - \frac{\cos\gamma_2}{Z^{(2)}}\right)\left(\frac{\cos\gamma_2}{Z^{(2)}} + \frac{\cos\gamma_3}{Z^{(3)}}\right)$$

$$(38)\quad B_1 = \exp\left[j(c_2^{(2)} + c_2^{(1)})h\right]\left(\frac{\cos\gamma_2}{Z^{(2)}} + \frac{\cos\gamma_1}{Z^{(1)}}\right)\left(\frac{\cos\gamma_3}{Z^{(3)}} - \frac{\cos\gamma_2}{Z^{(2)}}\right)$$

$$(39)\quad A_2 = \exp\left[j(c_2^{(2)} - c_2^{(1)})h\right]\left(\frac{\cos\gamma_1}{Z^{(1)}} + \frac{\cos\gamma_2}{Z^{(2)}}\right)\left(\frac{\cos\gamma_2}{Z^{(2)}} + \frac{\cos\gamma_3}{Z^{(3)}}\right)$$

$$(40)\quad B_2 = \exp\left[j(c_2^{(2)} + c_2^{(1)})h\right]\left(\frac{\cos\gamma_2}{Z^{(2)}} + \frac{\cos\gamma_1}{Z^{(1)}}\right)\left(\frac{\cos\gamma_3}{Z^{(3)}} - \frac{\cos\gamma_2}{Z^{(2)}}\right)$$

By another arrangement of terms, $r^{(1)}$ can be written in the form $(a-b)/(a+b)$ usual for reflection coefficients. In these equations we have following (27) (28)

$$(41)\quad c_1^{(1)} = c_1^{(2)} = c_1^{(3)} = k_1 \sin\gamma_1 = k_2 \sin\gamma_2 = k_3 \sin\gamma_3$$

$$(42)\quad k_3 = k_1\,; \quad \sin\gamma_1 = \sin\gamma_3\,, \quad Z^{(1)} = Z^{(3)}$$

We are interested in the case of the total reflection in $z = 0$, if the third medium would be identical with the second one. Then we have

$$(43)\quad \sin\gamma_2 = \frac{k_1}{k_2}\sin\gamma_1 \geqslant 1$$

With

$$(44)\quad \gamma_2 = \alpha_2 + j\beta_2$$

we found:

$$(45)\quad \sin(\alpha_2 + j\beta_2) = \sin\alpha_2 \cosh\beta_2 + j\cos\alpha_2 \sinh\beta_2, \ \text{real} \geqslant 1$$

$$(46)\quad \cos\alpha_2 \sinh\beta_2 = 0, \quad \sin\alpha_2 \cosh\beta_2 > 1$$

consequently $(\beta_2 \neq 0)$

(47) $\sin\alpha_2 = 1 \quad , \quad \alpha_2 = \pi/2$

(48) $\cos\gamma_2 = \sqrt{1-\sin^2\gamma_2} = \sqrt{1-\cosh^2\beta_2} = \pm j\sinh\beta_2$

Now we have:

(49) $\cos\gamma_2 = \cos(\alpha_2 + j\beta_2) = \cos\alpha_2\cosh\beta_2 - j\sin\alpha_2\sinh\beta_2$
$= -j\sinh\beta_2$

and therefore:

(50) $\exp[j\xi_2^{(2)}h] = \exp[jk_2\cos\gamma_2 h] = \exp[\pm k_2 h\sinh\beta_2]$

is to be attenuated expoentially with increasing h ;
for $h \to \infty$, $r^{(1)}$, $t^{(2)}$ must become equal to the well known coefficients of reflection and transmission between two media; thus we have

(49a) $\cos\gamma_2 = +j\sinh|\beta_2|$

that is to say in equation (49) β_2 is to be chosen as negative. For controlling our calculus we study this limiting case:

(51) $\lim\limits_{h\to\infty} \exp[j\xi_2^{(2)}h] \to \exp\limits_{h\to\infty}[-|\xi_2^{(2)}|h] \to 0$

and we get:

(52) $t^{(2)} \to 0$ (in an infinite heightthere does not more exist any field)

(53) $r^{(2)} \to 0$ from the infinity no reflected wave does returne.

$$(54) \quad t^{(2)} \rightarrow \frac{2\cos\gamma_1 / Z^{(1)}}{\frac{\cos\gamma_2}{Z^{(2)}} + \frac{\cos\gamma_1}{Z^{(1)}}}$$

$$(55) \quad r^{(1)} \rightarrow \frac{\frac{\cos\gamma_1}{Z^{(1)}} - \frac{\cos\gamma_2}{Z^{(2)}}}{\frac{\cos\gamma_1}{Z^{(1)}} + \frac{\cos\gamma_2}{Z^{(2)}}} = r_{12},$$ Fresnels refl.coeff. between medium 1,2

We have found in this limit the well known values of $r^{(1)}, t^{(2)}$ between two media. Energy-radiation in the mean in the z-direction is due to the components E_x and H_y. As $\cos\gamma_2$ is imaginary, it follows from the equations (10) (11) (48): The phase between them is $\pi/2$, so that no energy is transmitted in the z-direction in the mean.

Here we know the mechanism of the transmission of energy to the third layer: if a reflected wave returns from it these phaserelation is disturbed, an energy is transmitted in the z-direction.

We join still some supplementary remarks:
At first it seems to be of a certain interest how the resulting reflection coefficient is composed of the reflection coefficients of the media 1,2, and 2,3 alone, if the separating plain between hese media would be placed in z = 0. In (55) we have already indicated the reflection coefficient r_{12}. Analogously the reflection coefficient for the media 2,3 is

$$(56) \quad r_{2,3} = \frac{\frac{\cos\gamma_2}{Z^{(2)}} - \frac{\cos\gamma_3}{Z^{(3)}}}{\frac{\cos\gamma_2}{Z^{(2)}} + \frac{\cos\gamma_3}{Z^{(3)}}}$$

for transition in $z = 0$.
Since this transition takes place in $z = h$ we have to join the coefficient $\exp[j \cdot 2\zeta_2^{(2)} h]$ describing the phase difference due to the double way there and back between $z = 0$ and $z = h$. In equation (36) we devide numerator and denominator by

$$\exp[-j\zeta_2^{(2)} h]\left(\frac{\cos\gamma_1}{Z^{(1)}} + \frac{\cos\gamma_2}{Z^{(2)}}\right)\left(\frac{\cos\gamma_2}{Z^{(2)}} + \frac{\cos\gamma_3}{Z^{(3)}}\right)$$

and we find:

$$(57)\quad r^{(1)} = \frac{r_{12} + \exp[2jc_2^{(2)}h]\,r_{23}}{1 + r_{12}r_{23}\exp[2jc_2^{(2)}h]}$$

As $\exp[2jc_2^{(2)}h]$ contains the exponential attenuation, we see, that with $h \to \infty$ the reaction of the third medium disappears exponentially.
From equation (57) we wish to see that apart from the case of grazing incidence ($\gamma_1 = \pi/2$, $r_{12} = -1$) $r^{(1)} < 1$ on particular if $r_{12} = 1$, the case of total reflection. r_{12} was given by equation (55); (49a) gave us $\cos\gamma_2$:

$$(49a)\quad \cos\gamma_2 = +j\sinh|\beta_2|$$ consequently

$$(58)\quad r_{12} = \frac{\frac{\cos\gamma_1}{Z^{(1)}} - j\frac{\sinh\beta_2}{Z^{(2)}}}{\frac{\cos\gamma_1}{Z^{(1)}} + j\frac{\sinh\beta_2}{Z^{(2)}}}$$, a quotient of

2 conjugate complex numbers: consequently

$$(59)\quad r_{12} = e^{-2j\varphi}$$ where

$$(60)\quad tg\,\varphi = \frac{\sinh|\beta_2|}{\cos\gamma_1}\,\frac{Z^{(1)}}{Z^{(2)}}$$

If $\varepsilon_3 = \varepsilon_1$, r_{21} is found by changing the signs 1 and 2 in r_{12}. Now we write down

$$(61)\quad r^{(1)} = \frac{\frac{\cos\gamma_1/Z^{(1)} - \cos\gamma_2/Z^{(2)}}{\cos\gamma_1/Z^{(1)} + \cos\gamma_2/Z^{(2)}} - \exp[-2k_2h\sinh|\beta_2|]\,\frac{\cos\gamma_2/Z^{(1)} - \cos\gamma_2/Z^{(2)}}{\cos\gamma_1/Z^{(1)} + \cos\gamma_2/Z^{(2)}}}{1 + \frac{\left(\frac{\cos\gamma_1}{Z^{(1)}} - \frac{\cos\gamma_2}{Z^{(2)}}\right)\left(\frac{\cos\gamma_2}{Z^{(2)}} - \frac{\cos\gamma_1}{Z^{(1)}}\right)}{\left(\frac{\cos\gamma_1}{Z^{(1)}} + \frac{\cos\gamma_2}{Z^{(2)}}\right)\left(\frac{\cos\gamma_2}{Z^{(2)}} + \frac{\cos\gamma_1}{Z^{(1)}}\right)}\exp[-2hk_2\sinh|\beta_2|]}$$

where $\cos\gamma_2 = -j\sinh|\beta_2|$

following (59) we put

$$(59a)\quad \frac{\dfrac{\cos\gamma_1}{Z^{(1)}} - j\dfrac{\sinh|\beta_2|}{Z^{(2)}}}{\dfrac{\cos\gamma_1}{Z^{(1)}} + j\dfrac{\sinh|\beta_2|}{Z^{(2)}}} = e^{-2j\varphi}$$

and we find

$$(62)\quad r^{(1)} = \frac{e^{-2j\varphi} - \exp[-2k_2 h \sinh|\beta_2|]\, e^{-2j\varphi}}{1 + \exp[-2k_2 h \sinh|\beta|]}$$

or

$$(63)\quad r^{(1)} = e^{-2j\varphi}\frac{(1-\delta)}{(1+\delta)}$$

with $\delta = \exp[-2k_2 h \sinh|\beta_2|]$.

We study the absolute value of $r^{(1)}$

Obiously $|r^{(1)}| < 1$.

Appendix I

<u>Prouve that Surfaces of Constant Phase and Constant Amplitude in a Non Dissipative Medium are Perpendicular One to Another</u> [1]

The wave equation

(1) $$\Delta u + k^2 u = 0$$

is resolved by separation of variables in cartesian coordinates in the form

(2) $$u = e^{\pm j k_x x} e^{\pm j k_y y} \cdot e^{\pm j k_z \cdot z}$$

where we put

(3) $$k_x = k_{1x} + j k_{2x}, \quad k_y = k_{1y} + j k_{2y}, \quad k_z = k_{1z} + j k_{2z}$$

and where we have

(4) $$k_x^2 + k_y^2 + k_z^2 = k^2$$

consequently

(5) $$k_{1x}^2 + k_{1y}^2 + k_{1z}^2 - k_{2x}^2 - k_{2y}^2 - k_{2z}^2 = k^2$$ and

(6) $$2j(k_{1x} k_{2x} + k_{1y} k_{2y} + k_{1z} k_{z}) = 0$$

A plane of constant phase is given by

(7) $$k_{1x} x + k_{1y} y + k_{1z} z = \mathrm{const}$$

and a plane of constant amplitude by

(8) $$k_{2x} x + k_{2y} y + k_{2z} z = \mathrm{const}$$

Following (6) these planes are perpendicular one to another.

Appendix II

The Generation of Transversally Attenuated Waves by Means of Total Reflection in a Stratified Medium

Although some facts to be related here are known, we shall bring them because we need them for understanding of the theory to be developed.

With reference to Fig. 19, Fig. 20 we suppose two media:

In the half-space $y < 0$ $\qquad \varepsilon = \varepsilon_1$
in the half-space $y > 0$ $\qquad \varepsilon = \varepsilon_2 < \varepsilon_1$

Both types of plane waves to be studied are independent from x. The both types are given in the usual manner by their polarisation:

a) E perpendicular to the plane of incidence
b) H perpendicular to the plane of incidence

The angle of incidence ϑ is supposed to be small, so that total reflection arises. There in $y > 0$ waves of the desired type arise, the reflection and the refraction of which by dielectric half spaces is to be studied.

At first we suppose the new separating plane parallel to the xz plane, later on we treat the case where these planes form any angle.

With $\exp[-j\omega t]$ as a time function we have thetwo types of waves defindet by

$$(1)\quad E_x, H_y, H_z \quad , \quad (2)\quad H_x, E_y, E_z$$

From Maxwell's equations we find immediately:

a) in the case E_x, H_y, H_z

$$(3)\quad \Delta E_x + k^2 E_x = 0, \quad k^2 = \omega^2 \varepsilon_0 \mu_0 \varepsilon \mu$$

In the first medium:

$$(4)\quad E_x = \exp[-jk_1 z \cos\vartheta_1 + jk_1 y \sin\vartheta_1]$$

$$(5)\quad H_y = \frac{1}{j\omega\mu_0\mu}\frac{\partial E_x}{\partial z} = -\frac{\cos\vartheta_1}{Z^{(1)}}\exp[-jk_1 z\cos\vartheta_1 + jk_1 y\sin\vartheta_1]$$

$$(6)\quad H_z = \frac{-1}{j\omega\mu_0\mu}\frac{\partial E_x}{\partial y} = -\frac{\sin\vartheta_1}{Z^{(1)}}\exp[-jk_1 z\cos\vartheta_1 + jk_1 y\sin\vartheta_1]$$

These equations ware valid in $y < 0$, Med. 1. $Z^{(1)}$ is the wave impedance of the first medium.

In the case of the another polarisation we have

$$(7)\quad \Delta H_x + k^2 H_x = 0$$

and

$$(8)\quad H_x = \exp[-jk_1 z\cos\vartheta_1 + jk_1 y\sin\vartheta_1]$$

$$(9)\quad E_y = -\frac{1}{j\omega\varepsilon_0\varepsilon}\frac{\partial H_x}{\partial z} = Z^{(1)}\cos\vartheta_1\exp[-jk_1 z\cos\vartheta_1 + jk_1 y\sin\vartheta_1]$$

$$(10)\quad E_z = \frac{1}{j\omega\varepsilon_0\varepsilon}\frac{\partial H_x}{\partial y} = -Z^{(1)}\sin\vartheta_1\exp[-jk_1 z\cos\vartheta_1 + jk_1 y\sin\vartheta_1]$$

Since we need in what follows the transmitted wave only, we wish to find the wave penetrating into the second medium only. We do not calculate the transmission coefficient but we are only interested in the type of this wave arising from the law of refraction. Also we normalise the wave by the amplitude coefficient 1. The wave, penetrating in the second medium can be written formally by replacing the index 1 (in k_1, $Z^{(1)}$, $\cos\vartheta_1$, $\sin\vartheta_1$) by the index 2 (k_2, $Z^{(2)}$, $\cos\vartheta_2$, $\sin\vartheta_2$).

The case in which we are interested consists of complex values of ϑ_2 . From the law of refraction

we have

(11) $\sqrt{\varepsilon_1}\cos\vartheta_1 = \sqrt{\varepsilon_2}\cos\vartheta_2, \quad \cos\vartheta_2 = \sqrt{\frac{\varepsilon_1}{\varepsilon_2}}\cos\vartheta_1$

Since $\varepsilon_2 < \varepsilon_1$ for $y > 0$ the desired type of wave arises if

(12) $\cos\vartheta_2 > 1$

The limiting angle of total reflection is defined by

(13) $\cos\vartheta_2 = 1$

In this case in $y > 0$, medium 2, we should have the wave

(14) $\exp[-jk_2 z]$

But, if $\cos\vartheta_2 > 1$, ϑ_2 is complex and we write:

(15) $\vartheta_2 = u + jv$

(16) $\cos\vartheta_2 = \cos u \cosh v - j \sin u \sinh v$

(17) $\sin\vartheta_2 = \sin u \cosh v + j \cos u \sinh v$

These values are to be inserted in equations (4) (5) (6) (8) (9) (10) in the places of $\cos\vartheta_1, \sin\vartheta_1$, also $Z^{(1)}$ is to be replaced by $Z^{(2)}$. If $\cos\vartheta_2 > 1$, real, we have

(18) $\sin u \sinh v = 0, \quad u = 0$

(19) $\cos\vartheta_2 \qquad = \cosh v$

(20) $\sin\vartheta_2 \qquad = j \sinh v$

from what follows

(21) $\cos^2\frac{\vartheta}{2} + \sin^2\frac{\vartheta}{2} = 1 = \cosh^2 v - \sinh^2 v$

For both polarisations it turns out the exponential factor

(22) $\exp[-jk_2 z\cosh v - k_2 y \sinh v]$

From (12) (19) (20) it follows that:
For a variable ϑ

(23) $1 \leq \cosh v = \sqrt{\frac{\varepsilon_1}{\varepsilon_2}}$

(24) $0 \leq \sinh v = \sqrt{\frac{\varepsilon_1}{\varepsilon_2} - 1}$

The attenuation in the y direction becomes

(25) $\exp[-k_2 y \sinh v]$

A diminuation until a factor $1/e$ takes place along a distance given by y_0 :

(26) $k_2 y_0 \sinh v = 1, \quad y_0 = \frac{1}{k_2 \sinh v} = \frac{\lambda_2}{2\pi}\frac{1}{\sinh v}$

where

(27) $\sinh v = \sqrt{\cosh^2 v - 1}$

from what follows:

(28) $y_0 = \dfrac{\lambda/2\pi}{\sqrt{\frac{\varepsilon_1}{\varepsilon_2}\cos^2\vartheta_1 - 1}}$

The wave normal (= phase normal) of this wave lies in the z-direction.

The phase normal (= real part of Poyntings vector)

is now to be defined as the direction of incidence of the wave.

In the case of a continous stratification [18][9] we see also transversally attenuated waves arising by total reflection.

Appendix III

Riemann-Lebesgue's Lemma in Samans's Representation.

Theorem 1: Let $h(t)$ be two time continuously differentiable

$h'(t) \neq 0$ in $\alpha \leq t \leq \beta$

$\varphi(t)$ of bounded variation in $\alpha \leq t \leq \beta$

Then: $J = \int_{\alpha}^{\beta} \varphi(t) \exp[j k h(t)]\, dt = O(1/k)$

Prouve: Let J be interpreted as a Stieltjes-Integral:

$$\int_{\alpha}^{\beta} \varphi(t) e^{jkh(t)} dt = \int_{t=\alpha}^{t=\beta} \varphi(t(u)) e^{jku} \frac{du}{h'(t(u))} \quad \text{with} \quad h(t) = u, \quad h'(t) = \frac{du}{dt} \neq 0$$

the solution of the equation $h(t) = u$ with respect to t is possible in the form $t = f(u)$ and it follows:

$$J = \int_{t=\alpha}^{t=\beta} \varphi(f(u)) \frac{1}{h'(f(u))} d\left(\frac{e^{jku}}{jk}\right)$$

By means of partial integration we find:

$$J = \int_{t=\alpha}^{t=\beta} \frac{\varphi}{h'} d\frac{e^{jku}}{jk} = \left[\frac{\varphi(t)}{h'(t)} \frac{e^{jkh(t)}}{jk}\right]_{t=\alpha}^{t=\beta} - \int_{t=\alpha}^{t=\beta} \frac{e^{jku}}{jk} d\left(\frac{\varphi(f(u))}{h'(f(u))}\right)$$

$$= O\left(\frac{1}{k}\right) + R$$

and

$$|R| = \left| \int_{t=\alpha}^{t=\beta} \frac{e^{jku}}{jk} d\left(\frac{\varphi(f(u))}{h'(f(u))}\right) \right| \leq \sup \left| \frac{e^{jkh(t)}}{jk} \right| \left[\mathrm{Var} \frac{\varphi(t)}{h'(t)} \right]_{t=\alpha}^{t=\beta}$$

Since $\varphi(t)$ is supposed being of bounded variation, $h'(t)$ continuously differentiable $\neq 0$, we have

$$\left[\operatorname{Var}\frac{1}{h'(t)}\right]_\alpha^\beta = \int_\alpha^\beta \left|\frac{h''(t)}{h'(t)^2}\right| dt \leq K$$

and therefore: $R = O(1/k)$

(The product of two functions of bounded variation is of bounded variation)

Theorem 2: $h(t)$ two time continuously differentiable Let exist τ : $\alpha \leq \tau \leq \beta$ so that $h'(\tau)=0,\ h''(\tau)>0$ $\varphi(t)$ continuously differentiable. $\mathcal{J}$ is to be represented in an asymptotic manner by

$$\mathcal{J} \sim \left[\frac{2\pi}{k h''(\tau)}\right]^{1/2} \varphi(\tau) \exp\left[j k\left(h(\tau) + \frac{\pi}{4}\right)\right] + O\left(\frac{1}{k}\right)$$

This representation runs by means of saddle points method (stationary phase or steepest descent) (Cf. [6] and many text books on saddle points method).

Appendix IV

Situation of The Saddle-Points in Samans's Calculus

Our calculus differs from Samans's one by the slowly variable factor $\exp[-p(\vec{A}\cdot\vec{\ell})]$ not influencing the situation of the saddle point.
Apart from this factor the exponent in the integral

$$h(t) = (\vec{A}\cdot\vec{\ell}(t)) + |\vec{\ell}(t) - \vec{\ell}(s)|$$

t is the parameter of curve length of the boundary of the diffracting cylinder. s is the value of t correspon-

ding to the point of observation. Then:

$$h'(t) = (\vec{A}\cdot\vec{t}) + \left(\frac{(\vec{\varphi}(t)-\vec{\varphi}(s))}{|\vec{\varphi}(t)-\vec{\varphi}(s)|}\cdot\vec{t}\right)$$

where $\vec{t}$ is the tangential unit vector in t . $h'(t)$ disappears in two cases:

1) $\vec{A} = -\dfrac{\vec{\varphi}(t)-\vec{\varphi}(s)}{|\vec{\varphi}(t)-\vec{\varphi}(s)|}$ (saddle point of 1st kind)

i.e. $\vec{A}$ and $\vec{r}$, the vector from the point of integration t to the point of observation s are antiparallel. But for disappearing of $h'(t)$ this is not necessary. It is sufficient (Fig. 5) that $\vec{A}$ and $(\vec{\varphi}(t)-\vec{\varphi}(s))/|\vec{\varphi}(t)-\vec{\varphi}(s)|$ have opposite component of equal absolute value, i.e.:

2) $(\vec{A}\cdot\vec{n}) = +\left(\dfrac{(\vec{\varphi}(t)-\vec{\varphi}(s))}{|\vec{\varphi}(t)-\vec{\varphi}(s)|}\cdot\vec{n}\right)$ (saddle point of second kind)

It is easy to see that on C_1 no saddle point is existing.

Appendix V

Admissibility of Replacing $H_1^{(1)}(kr)$ in the Integral (37) p. 20 by Its Asymptotic Representation in the Neighbourhood of $r=0$

In the integral (37) $H_1^{(1)}(kr)$ is replaced by its asymptotic representation. Apart from a little intervall in r about $r=0$ for $k\to\infty$ this proceeding is certainly admissible. However Samans does not give a sufficient account of this step in his calculus. The integral (37) converges in $r=0$ but the admissibility of this replacing is to be prouved explicitely. This will be done here.

$r=0$ in the integral arises only, if s, the point of observation is placed on the illuminated side, on C_1 In this case for $k\to\infty$ the integral

$$\int_{C_1} \mathcal{F} \frac{\partial \mathcal{H}_0^{(1)}(kr)}{\partial n}\, dl = -\int_{C_1} \mathcal{F}\, \mathcal{H}_1^{(1)}(k|\vec{e}(t)-\vec{e}(s)|)\, k\left(\frac{\vec{n}\cdot\vec{r}}{|\vec{r}|}\right) dl$$

$$\left(\vec{r} = \vec{e}(t)-\vec{e}(s)\,,\quad |\vec{r}| = |\vec{e}(t)-\vec{e}(s)|\right)$$

goes $\rightarrow 0$.

We have to show that the replacing of $\mathcal{H}_1^{(1)}(kr)$ by its asymptotic representation is allowed. $\mathcal{H}_1^{(1)}(kr)$ is $O(1/kr)$ for $r \rightarrow 0$, $(\vec{n}\cdot\vec{r})/|\vec{r}| = \cos(\vec{n},\vec{r}) = \sin\alpha$, where α is the angle of contigency.

It is well known that $\sin\alpha = t/\varrho$ (ϱ = radius of curvature $\neq 0$) in the neighbourhood of t = 0, the integrand remains finite.

But we have to show that the replacing of $\mathcal{H}_1^{(1)}(kr)$ by its asymptotic representation is allowed in estimating the integral for $k \rightarrow \infty$. For C_1 outside an intervall $-a < t < a$ the calculus of Samans is correct and we wish to calculate an integral of the form:

$$\mathcal{J} = \int_{-a}^{+a} \mathcal{F}(t)\, \mathcal{H}_1^{(1)}(k|t|)\,|t|\, dl$$ a any value as little as we like.

We have written $\mathcal{H}_1^{(1)}(k|t|)\,|t|\, dl$: this is evident in (37) because r is always positive. We take t (the parameter of the curve length, in the neighbourhood of $r = 0$ equal r) so that $t = 0$ in $r = 0$

Now we have

$$t < 0 \qquad |t| = -t$$
$$t > 0 \qquad |t| = t$$

The integral is decomposed in two parts:

$$\mathcal{J} = \int_{-a}^{0} + \int_{0}^{+a}; \quad \text{in } -a < t < 0$$ we have:

$$|t|\,\mathcal{H}_1^{(1)}(k|t|) = -t\,\mathcal{H}_1^{(1)}(-kt)$$

In $0<t<a$ we have

$$|t|\mathcal{H}_1^{(1)}(h|t|) = t\,\mathcal{H}_1^{(1)}(ht)$$

consequently

$$\mathcal{J}=\int_{-a}^{0} F(ht)\,\mathcal{H}_1^{(1)}(-ht)(-t)\,dt+\int_{0}^{a} F(ht)\,\mathcal{H}_1^{(1)}(ht)\,t\,dt$$

in the first of these integrals we use the well known relation:

$$\mathcal{H}_1^{(1)}(ht\,e^{i\pi}) = -\mathcal{H}_1^{(1)}(ht) - 2J_1(ht)\text{; then}$$

$$\mathcal{J}=\int_{-a}^{0} F(ht)\,\mathcal{H}_1^{(1)}(ht)\,t\,dt+\int_{0}^{a} F(ht)\,\mathcal{H}_1^{(1)}(ht)\,t\,dt$$

$$-2\int_{-a}^{0} F(ht)\,J_1(ht)\,t\,dt$$

$$\mathcal{J}=\int_{-a}^{+a} F(ht)\,\mathcal{H}_1^{(1)}(ht)\,t\,dt-2\int_{-a}^{0} F(ht)\,J_1(ht)\,t\,dt$$

At first we turn ourselves to the second integral on the right hand side:
In the well known textbook of Watson about Bessel-Functions we find on page 595 an analogon to Riemann-Lebesgues Lemma by replacing of cos/sin functions by Bessel-functions from what follows immediately:

$$\int_{-a}^{0} F(ht)\,J_1(ht)\,t\,dt = O\left(\frac{1}{\sqrt{h}}\right) \to 0$$

Than we observe the first integral on the right hand side: Fixing the endpoints $\pm a$ we transform the contour in the complex t-plane into a half circle about t = 0 with radius a in the upper half plane, supposing that no irregularity of $\mathfrak{F}$ takes place in this domain. Then on this path, every where in the fixe distance a from t = 0 we replace $\mathcal{H}_1^{(1)}(kt)$ by its asymptotic representation, being a regulary function apart from the origin. The path of this integral, containing a regulary function can be transfered back to the old path, surrounding t = 0 by a little half-circle of a radius as small as on likes. A branchcut is to be situated in the lower half plane in order to not influence our proceeding.

The integral over the half circle quoted disappears for $k \to \infty$ by Riemann-Lebesgue's lemma.

Appendix VI

Survey of The Rigorous Solution in an Epstein Layer

The author has treated in two papers the propagation of waves in stratified medium, the simple structure of which allows a rigorous solution of the wave equation. The same medium is also treated by Seckler's and Keller's method. For sparing to consult these papers of the author we give an abbreviated survey of their contents in so far as we need it for understanding the present treatise. The function representing the dielectric constant as a function of z is

$$(1) \quad \varepsilon = 1 + \frac{\delta}{1+e^{\varkappa z}} \qquad \begin{matrix} \delta > 0 \\ \varkappa > 0 \end{matrix}$$

This function is represented in Fig. 1. For

$$(2) \quad z \to +\infty \qquad \varepsilon \to 1$$

in the domain $\frac{2}{\varkappa} > z > -\frac{2}{\varkappa}$

ε increases approximatively in a linear manner ($\varepsilon(0) = 1 + \frac{\delta}{2}$) to $\varepsilon = 1 + \delta$ for $z \to -\infty$.

Fig. 1 shows that it is reasonable to denote the intervall $2/\varkappa > z > -2/\varkappa$ by the "layer of inhomogeneity" and $4/\varkappa$ by "the layer-thickness".

Let a wave E_x, H_y, H_z be incident, $E_x = u$ fullfills the wave equation:

$$(3) \quad \frac{\partial^2 u}{\partial z^2} + \frac{\partial^2 u}{\partial y^2} + \omega^2 \varepsilon_0 \mu_0 \mu \, \varepsilon(z) u = 0$$

$$(4) \quad \mu = 1, \quad k_0^2 \overset{\mathrm{def}}{=} \omega^2 \varepsilon_0 \mu_0$$ (the field is independent from x)

By separation of the variables we find:

$$(5)\quad E_x = u(z,y) = e^{\pm j G y} Z(z)$$

The wave equation for $Z(z)$ is transformed in a way due to Epstein and used by Rawer in a very sucessfull manner [21] [22] : by means of

$$(6)\quad \zeta = -e^{\varkappa z}$$

we obtain solutions of the form:

$$u = \zeta^{\frac{\gamma-1}{2}} (1-\zeta)\, {}_2F_1(\alpha,\beta;\gamma;\zeta)$$

where ${}_2F_1$ denotes the hypergeometric function and $\alpha,\beta;\gamma;$ are defined by

$$\alpha = 1 + j\frac{k_0}{\varkappa}\left(\sqrt{(1+\delta)-\varepsilon(z_0)\sin^2\vartheta_0} - \sqrt{1-\varepsilon(z_0)\sin^2\vartheta_0}\right);$$

$$(7)\quad \beta = 1 + j\frac{k_0}{\varkappa}\left(\sqrt{(1+\delta)-\varepsilon(z_0)\sin^2\vartheta_0} + \sqrt{1-\varepsilon(z_0)\sin^2\vartheta_0}\right);$$

$$\gamma = 1 + 2j\frac{k_0}{\varkappa}\sqrt{(1+\delta)-\varepsilon(z_0)\sin^2\vartheta_0}\,.$$

$\sin\vartheta_0$ is the sinus of the angle of incidence chosen for a value z_0 , where $\varepsilon = \varepsilon(z_0)$.
Hypergeometric functions offer very interesting relations, furnishing important physical consequences here: It is easy to see, that:

$$(8)\quad v_1 = \zeta^{\frac{\gamma-1}{2}} (1-\zeta)\, {}_2F_1(\alpha,\beta;\gamma;\zeta)$$

corresponds to a wave incident from below i.e. from $z \to -\infty$, going in the direction of positive z $(\exp(-j\omega t))$.
It is well known that the series representing ${}_2F_1(\alpha,\beta,\gamma;\zeta)$ converges only inside the circle $|\zeta| = 1$. By analytic

continuation we see that:

$$(9)\quad v_2 = \zeta^{\frac{\gamma-1}{2}}(1-\zeta)\,{}_2F_1\left(\alpha, \alpha-\gamma+1; \alpha-\beta+1; \frac{1}{\zeta}\right)$$

corresponds to a wave going in the +z direction in $z \to +\infty$, converges in $|1/\zeta| < 1$;

$$(10)\quad v_3 = \zeta^{\frac{\gamma-1}{2}}(1-\zeta)\,\zeta^{1-\gamma}\,{}_2F_1(\alpha-\gamma+1, \beta-\gamma+1; 2-\gamma; \zeta)$$

is a wave going in the -z direction for $z \to -\infty$ convergent in $|\zeta| < 1$.

Between these three functions there exists the following relation:

$$(11)\quad v_2 = \frac{\Gamma(1-\gamma)\Gamma(\alpha+1-\beta)}{\Gamma(1-\beta)\Gamma(\alpha+1-\gamma)}\, v_1 - \frac{\Gamma(\gamma)\Gamma(1-\gamma)\Gamma(\alpha+1-\beta)}{\Gamma(2-\gamma)\Gamma(\gamma-\beta)\Gamma(\alpha)}\, e^{i\pi(\gamma-1)}\, v_3$$

v_2 is essentially an exponential function for $z \to +\infty$
v_1 and v_2 are also exp. functions for $z \to -\infty$
Deviding the latter equation by the coefficient of v_1
we get:

$$(12)\quad \frac{\Gamma(1-\beta)\,\Gamma(\alpha+1-\gamma)}{\Gamma(1-\gamma)\,\Gamma(\alpha+1-\beta)}\,v_2 = v_1 - \frac{\Gamma(\gamma)\,\Gamma(1-\beta)\,\Gamma(1+\alpha-\gamma)}{\Gamma(2-\gamma)\,\Gamma(\gamma-\beta)\,\Gamma(\alpha)}\,e^{j\varkappa(\gamma-1)}\,v_3$$

This signifyes the following effect:
An incident wave v_1 $(z<0,\ 0>\zeta>-1)$ gives rise to a wave transmitted to $z \to +\infty$

$$\frac{\Gamma(1-\beta)\,\Gamma(\alpha+1-\gamma)}{\Gamma(1-\gamma)\,\Gamma(\alpha+1-\beta)}\,v_2 \qquad \begin{pmatrix} 0<z<\infty \\ -\infty<\zeta<-1 \end{pmatrix}$$

and to a reflected wave

$$-\frac{\Gamma(\gamma)\,\Gamma(1-\beta)\,\Gamma(1+\alpha-\gamma)}{\Gamma(2-\gamma)\,\Gamma(\gamma-\beta)\,\Gamma(\alpha)}\,e^{j\varkappa(\gamma-1)}\,v_3 \qquad \begin{pmatrix} z<0 \\ 0>\zeta>-1 \end{pmatrix}$$

We shall denote by R:

$$(13)\quad R = \frac{\Gamma(\gamma)\,\Gamma(1-\beta)\,\Gamma(1+\alpha-\gamma)}{\Gamma(2-\gamma)\,\Gamma(\gamma-\beta)\,\Gamma(\alpha)}$$

the coefficient of reflection, $\exp[j\varkappa(\gamma-1)]$ cancels out)

$$(14)\quad T = \frac{\Gamma(1-\beta)\,\Gamma(1+\alpha-\gamma)}{\Gamma(1-\gamma)\,\Gamma(1+\alpha-\beta)}$$

the coefficient of transmission

$$\zeta^{\frac{\gamma-1}{2}},\quad \zeta^{\frac{\gamma-1}{2}}\cdot\zeta^{1-\gamma},\quad (\zeta=-e^{\varkappa z})$$

represents exponential wave functions in the homogenous media; now we describe the distortion of the wave beyond the arising of reflections by "distortion functions" [20]: the distortion function of the incident wave is evidently

$$(15)\quad D_i(z) = (1+e^{\varkappa z})\,F_{21}\left\{ \begin{array}{l} 1+j\frac{k_0}{\varkappa}\left(\sqrt{1+\delta-\varepsilon(z_0)\sin^2\vartheta_0}-\sqrt{1-\varepsilon(z_0)\sin^2\vartheta_0}\right), \\ 1+j\frac{k_0}{\varkappa}\left(\sqrt{1+\delta-\varepsilon(z_0)\sin^2\vartheta_0}+\sqrt{1-\varepsilon(z_0)\sin^2\vartheta_0}\right); \\ 1+2j\frac{k_0}{\varkappa}\sqrt{1+\delta-\varepsilon(z_0)\sin^2\vartheta_0}; \end{array} -e^{\varkappa z}\right\}$$

for the reflected wave:

$$(16)\quad D_r(z) = \left(1+e^{\varkappa z}\right)\mathcal{F}_{21}\left\{\begin{matrix} 1 - j\frac{k_0}{\varkappa}\left(\sqrt{(1+\delta)-\varepsilon(z_0)\sin^2\vartheta_0} + \sqrt{1-\varepsilon(z_0)\sin^2\vartheta_0}\right), \\ 1 - j\frac{k_0}{\varkappa}\left(\sqrt{(1+\delta)-\varepsilon(z_0)\sin^2\vartheta_0} - \sqrt{1-\varepsilon(z_0)\sin^2\vartheta_0}\right); \\ 1 - 2j\frac{k_0}{\varkappa}\sqrt{(1+\delta)-\varepsilon(z_0)\sin^2\vartheta_0}; \end{matrix} \quad -e^{\varkappa z}\right\}$$

for the transmitted wave:

$$(17)\quad D_t(z) = \left(1+e^{-\varkappa z}\right)\mathcal{F}_{21}\left\{\begin{matrix} 1 + j\frac{k_0}{\varkappa}\left(\sqrt{(1+\delta)-\varepsilon(z_0)\sin^2\vartheta_0} - \sqrt{1-\varepsilon(z_0)\sin^2\vartheta_0}\right), \\ 1 + j\frac{k_0}{\varkappa}\left(\sqrt{(1+\delta)-\varepsilon(z_0)\sin^2\vartheta_0} + \sqrt{1-\varepsilon(z_0)\sin^2\vartheta_0}\right); \\ 1 + \qquad\qquad + 2j\frac{k_0}{\varkappa}\sqrt{1-\varepsilon(z_0)\sin^2\vartheta_0}; \end{matrix} \quad -e^{-\varkappa z}\right\}$$

The rigorous solution is now established clearely by exponential functions, distortion functions, reflection and transmission coefficients.

Appendix VII

Survey of Seckler's and Keller's Approximated Diffraction-Theory

The basic idea of Seckler and Keller consists of tracing a tube of rays. The power transmitted in this tube is everywhere the same one, from what follows, that in our case $u = E$ is proportional to $f^{-1/2}$ where f denotes the cross section of the tube depending from the coordinate z. For an eventual reflection by a discontinuity of ε, Fresnels laws are used. In our case of medium S. and K's theory neglects the continuously distributed multiple reflection by the continuous variation of ε.

It is of great interest to know exactly and numerically this error.

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List of values of $\omega, \delta, \varkappa, \vartheta_0$ used for numerical evaluation.

ω	$\varkappa$	δ	ϑ_0				
$3\cdot 10^7$	0,01	10^{-5}	0°	10°	70°	85°	87,5°
$3\cdot 10^7$	0,01	10^{-4}			70°	85°	87,5°
$3\cdot 10^7$	0,01	10^{-3}			70°	85°	87,5°
$3\cdot 10^7$	0,01	10^{-2}			70°	82,5°	
$3\cdot 10^7$	0,01	10^{-1}			70°		
$3\cdot 10^7$	0,1	10^{-5}	0°	10°	70°	85°	87,5°
$3\cdot 10^7$	0,1	10^{-4}			70°	85°	87,5°
$3\cdot 10^7$	0,1	10^{-3}			70°	85°	87,5°
$3\cdot 10^7$	0,1	10^{-2}			70°	82,5°	
$3\cdot 10^7$	0,1	10^{-1}			70°		
$3\cdot 10^7$	10	10^{-5}	0°	10°	70°		
$3\cdot 10^7$	10	10^{-4}			70°		
$3\cdot 10^7$	10	10^{-3}			70°		
$3\cdot 10^7$	10	10^{-2}			70°	82,5°	
$3\cdot 10^7$	10	10^{-1}			70°		
$3\cdot 10^7$	0,01	10^{-3}			70°		
$3\cdot 10^8$	0,1	10^{-3}			70°		
$3\cdot 10^9$	0,01	10^{-3}			70°		
$3\cdot 10^7$	0,0001	10^{-3}			70°		
$3\cdot 10^8$	0,001	10^{-3}			70°		
$3\cdot 10^9$	0,01	10^{-3}			70°		
$3\cdot 10^{[illegible]}$	0,1	10^{-3}			70°		
$3\cdot 10^4$	1	10^{-3}			70°		

OMEGA 30000000 KAPPA 0.0100 DELTA 0.000010 VECTORLENGTH 0.21
REFLECTIONFACTOR 0 3.1419504 TRANSITFACTOR 1.0000026 0.0000002
ALPHA -0.00005 BETA -20.00005 GAMMA -20.00010

HEIGTH	THETA	E KELLER	ZETA		DISTORTION FUNCTION			
-1000.000	0	1.00000000	-0.00005	2'	1.00000000	0	0	0
-897.500	0	1.00000000	-0.00013	3'	1.00000000	0	0	0
-795.000	0	1.00000000	-0.00035	3'	1.00000000	0.00000001	0	0
-692.500	0	1.00000000	-0.00098	3'	1.00000000	0.00000005	0	0
-590.000	0	1.00000000	-0.00274	4'	1.00000001	0.00000013	0	0
-487.500	0	1.00000001	-0.00764	4'	1.00000002	0.00000038	0	0
-385.000	0	1.00000005	-0.02128	5'	1.00000006	0.00000105	0	0
-282.500	0	1.00000014	-0.05931	7'	1.00000014	0.00000288	0	0
-180.000	0	1.00000035	-0.16530	11'	1.00000036	0.00000763	0	0
-77.500	0	1.00000079	-0.46070	24'	1.00000079	0.00001891	0	0
25.000	0	1.00000140	-0.77880	73'	1.00000150	0.00002895		
127.500	0	1.00000195	-0.27943	15'	1.00000206	0.00001249		
230.000	0	1.00000227	-0.10026	8'	1.00000237	0.00000496		
332.500	0	1.00000241	-0.03597	6'	1.00000251	0.00000196		
435.000	0	1.00000246	-0.01291	5'	1.00000257	0.00000084		
537.500	0	1.00000248	-0.00463	4'	1.00000259	0.00000043		
640.000	0	1.00000250	-0.00166	3'	1.00000260	0.00000028		
742.500	0	1.00000250	-0.00060	3'	1.00000260	0.00000023		
845.000	0	1.00000250	-0.00021	3'	1.00000260	0.00000021		
947.500	0	1.00000250	-0.00008	2'	1.00000260	0.00000020		
1050.000	0	1.00000250	-0.00003	2'	1.00000260	0.00000020		

OMEGA 3000000 KAPPA 0.0100 DELTA 0.000010 VECTORLENGTH 0.20
REFLECTIONFACTOR 0 3.1419544 TRANSITFACTOR 1.0000025 0
ALPHA -0.00005 BETA -19.69620 GAMMA -19.69625

HEIGTH	THETA	E KELLER	ZETA		DISTORTION FUNCTION			
-1000.000	0.1745329	1.00000000	-0.00005	2'	1.00000000	0	0	0
-901.519	0.1745329	1.00000000	-0.00012	2'	1.00000000	0	0	0
-803.038	0.1745329	1.00000000	-0.00033	3'	1.00000000	0.00000001	0	0
-704.558	0.1745329	1.00000000	-0.00087	3'	1.00000000	0.00000004	0	0
-606.077	0.1745329	1.00000000	-0.00233	3'	1.00000000	0.00000012	0	0
-507.596	0.1745329	1.00000001	-0.00625	4'	1.00000001	0.00000031	0	0
-409.115	0.1745329	1.00000004	-0.01672	5'	1.00000004	0.00000084	0	0
-310.635	0.1745330	1.00000011	-0.04476	6'	1.00000011	0.00000222	0	0
-212.154	0.1745330	1.00000028	-0.11985	9'	1.00000028	0.00000574	0	0
-113.673	0.1745331	1.00000064	-0.32087	16'	1.00000063	0.00001411	0	0
-15.192	0.1745333	1.00000122	-0.85905	119'	1.00000115	0.00003146	0	0
83.289	0.1745335	1.00000185	-0.43479	22'	1.00000173	0.00001831		
181.769	0.1745337	1.00000228	-0.16240	10'	1.00000215	0.00000763		
280.250	0.1745338	1.00000250	-0.06056	7'	1.00000235	0.00000298		
378.731	0.1745338	1.00000260	-0.02266	5'	1.00000244	0.00000113		
477.212	0.1745338	1.00000263	-0.00846	4'	1.00000248	0.00000042		
575.692	0.1745338	1.00000264	-0.00316	4'	1.00000249	0.00000016		
674.173	0.1745338	1.00000265	-0.00118	3'	1.00000250	0.00000006		
772.654	0.1745338	1.00000266	-0.00044	3'	1.00000250	0.00000002		
871.135	0.1745338	1.00000266	-0.00016	3'	1.00000250	0.00000001		
969.615	0.1745338	1.00000266	-0.00006	2'	1.00000250	0		
1068.096	0.1745338	1.00000266	-0.00002	2'	1.00000250	0		

OMEGA 3000000 KAPPA 0.0100 DELTA 0.00010 VECTORLENGTH 0.40
REFLECTIONFACTOR 0 3.1423241 TRANSITFACTOR 1.0000214 0
ALPHA -0.00015 BETA -6.84029 GAMMA -6.84044

HEIGTH	THETA.	E KELLER	ZETA		DISTORTION FUNCTION			
-1000.000	1.2217305	1.00000000	-0.00005	2'	1.00000000	0	0	0
-931.596	1.2217305	1.00000000	-0.00009	2'	1.00000000	0.00000001	0	0
-863.192	1.2217305	1.00000000	-0.00018	3'	1.00000000	0.00000002	0	0
-794.788	1.2217305	1.00000001	-0.00035	3'	1.00000001	0.00000005	0	0
-726.384	1.2217305	1.00000003	-0.00070	3'	1.00000001	0.00000010	0	0
-657.980	1.2217305	1.00000004	-0.00139	3'	1.00000003	0.00000020	0	0
-589.576	1.2217305	1.00000010	-0.00275	4'	1.00000006	0.00000039	0	0
-521.172	1.2217305	1.00000020	-0.00545	4'	1.00000011	0.00000077	0	0
-452.768	1.2217306	1.00000042	-0.01081	4'	1.00000023	0.00000154	0	0
-384.364	1.2217308	1.00000084	-0.02142	5'	1.00000044	0.00000303	0	0
-315.960	1.2217310	1.00000163	-0.04244	6'	1.00000085	0.00000595	0	0
-247.556	1.2217315	1.00000312	-0.08412	8'	1.00000163	0.00001159	0	0
-179.152	1.2217324	1.00000573	-0.16671	11'	1.00000301	0.00002216	0	0
-110.748	1.2217339	1.00000998	-0.33039	17'	1.00000526	0.00004115	0	0
-42.345	1.2217359	1.00001592	-0.65478	43'	1.00000843	0.00007288	0	0
26.058	1.2217382	1.00002272	-0.77060	70'	1.00001211	0.00008275		
94.461	1.2217403	1.00002895	-0.38883	20'	1.00001546	0.00004739		
162.863	1.2217419	1.00003364	-0.19520	12'	1.00001793	0.00002576		
231.265	1.2217430	1.00003660	-0.09900	8'	1.00001950	0.00001355		
299.666	1.2217435	1.00003831	-0.04995	7'	1.00002040	0.00000699		
368.068	1.2217439	1.00003924	-0.02521	5'	1.00002089	0.00000357		
436.469	1.2217440	1.00003972	-0.01272	5'	1.00002113	0.00000181		
504.871	1.2217441	1.00003997	-0.00642	4'	1.00002126	0.00000092		
573.272	1.2217442	1.00004010	-0.00324	4'	1.00002133	0.00000046		
641.674	1.2217442	1.00004017	-0.00163	3'	1.00002136	0.00000023		
710.075	1.2217442	1.00004020	-0.00082	3'	1.00002138	0.00000012		
778.477	1.2217442	1.00004023	-0.00042	3'	1.00002139	0.00000006		
846.878	1.2217442	1.00004024	-0.00021	3'	1.00002139	0.00000003		
915.280	1.2217442	1.00004024	-0.00011	2'	1.00002140	0.00000001		
983.681	1.2217442	1.00004024	-0.00005	2'	1.00002139	0.00000001		
1052.083	1.2217442	1.00004024	-0.00003	2'	1.00002139	0		

OMEGA 3000000 KAPPA 0.0100 DELTA 0.000010 VECTORLENGTH 0.40
ALPHA -0.00057 BETA -1.74255 GAMMA -1.74312
REFLECTIONFACTOR 0.0000151 3.1429255 TRANSITFACTOR 1.0003294 0.0000002

HEIGTH	THETA	E KELLER	ZETA	DISTORTION FUNCTION				
-1000.000	1.4835298	1.00000000	-0.00005	2'	1.00000001	0.00000002	0.00001512	3.14292552
-965.130	1.4835298	1.00000000	-0.00006	2'	1.00000001	0.00000003	0.00001512	3.14292553
-930.275	1.4835298	1.00000000	-0.00009	2'	1.00000002	0.00000004	0.00001512	3.14292555
-895.413	1.4835298	1.00000000	-0.00013	3'	1.00000003	0.00000005	0.00001512	3.14292556
-860.551	1.4835298	1.00000000	-0.00018	3'	1.00000004	0.00000008	0.00001512	3.14292558
-825.688	1.4835298	1.00000000	-0.00026	3'	1.00000006	0.00000011	0.00001512	3.14292562
-790.826	1.4835298	1.00000021	-0.00037	3'	1.00000009	0.00000016	0.00001512	3.14292566
-755.964	1.4835298	1.00000021	-0.00052	3'	1.00000013	0.00000022	0.00001512	3.14292573
-721.101	1.4835298	1.00000047	-0.00074	3'	1.00000018	0.00000032	0.00001512	3.14292582
-686.239	1.4835298	1.00000047	-0.00105	3'	1.00000026	0.00000045	0.00001512	3.14292596
-651.377	1.4835299	1.00000098	-0.00148	3'	1.00000037	0.00000064	0.00001512	3.14292614
-616.515	1.4835299	1.00000145	-0.00210	3'	1.00000052	0.00000091	0.00001512	3.14292641
-581.652	1.4835300	1.00000218	-0.00298	4'	1.00000074	0.00000128	0.00001512	3.14292679
-546.790	1.4835301	1.00000290	-0.00422	4'	1.00000104	0.00000182	0.00001512	3.14292733
-511.928	1.4835302	1.00000414	-0.00598	4'	1.00000148	0.00000258	0.00001512	3.14292808
-477.066	1.4835303	1.00000563	-0.00847	4'	1.00000209	0.00000365	0.00001512	3.14292915
-442.204	1.4835305	1.00000808	-0.01201	5'	1.00000295	0.00000516	0.00001512	3.14293067
-407.341	1.4835308	1.00001128	-0.01702	5'	1.00000417	0.00000731	0.00001512	3.14293282
-372.480	1.4835311	1.00001543	-0.02412	5'	1.00000589	0.00001034	0.00001512	3.14293584
-337.618	1.4835317	1.00002154	-0.03418	6'	1.00000830	0.00001461	0.00001512	3.14294011
-302.756	1.4835325	1.00003038	-0.04843	6'	1.00001167	0.00002062	0.00001512	3.14294612
-267.895	1.4835335	1.00004214	-0.06864	7'	1.00001635	0.00002906	0.00001512	3.14295457
-233.034	1.4835349	1.00005834	-0.09726	8'	1.00002281	0.00004085	0.00001512	3.14296636
-198.174	1.4835367	1.00007942	-0.13783	10'	1.00003163	0.00005726	0.00001512	3.14298277
-163.314	1.4835391	1.00010716	-0.19531	12'	1.00004350	0.00007991	0.00001512	3.14300542
-128.456	1.4835422	1.00014222	-0.27677	15'	1.00005915	0.00011088	0.00001512	3.14303639
-93.598	1.4835459	1.00018493	-0.39220	20'	1.00007930	0.00015270	0.00001512	3.14307821
-58.742	1.4835502	1.00023450	-0.55576	31'	1.00010435	0.00020823	0.00001512	3.14313374
-23.888	1.4835550	1.00028898	-0.78751	76'	1.00013423	0.00028046	0.00001512	3.14320597
10.964	1.4835599	1.00034591	-0.89616	165'	1.00018289	0.00031237		
45.814	1.4835648	1.00040185	-0.63246	40'	1.00021438	0.00023319		
80.663	1.4835693	1.00045392	-0.44636	23'	1.00024129	0.00017179		
115.509	1.4835733	1.00049910	-0.31503	16'	1.00026324	0.00012522		
150.354	1.4835766	1.00053693	-0.22234	12'	1.00028051	0.00009053		
185.198	1.4835792	1.00056739	-0.15693	10'	1.00029371	0.00006506		
220.041	1.4835813	1.00059097	-0.11076	9'	1.00030359	0.00004654		
254.883	1.4835828	1.00060864	-0.07817	8'	1.00031085	0.00003319		
289.724	1.4835840	1.00062217	-0.05518	7'	1.00031615	0.00002363		
324.564	1.4835848	1.00063175	-0.03894	6'	1.00031995	0.00001681		
359.405	1.4835854	1.00063886	-0.02749	6'	1.00032270	0.00001195		
394.245	1.4835859	1.00061378	-0.01940	5'	1.00032465	0.00000851		
429.085	1.4835862	1.00064771	-0.01369	5'	1.00032604	0.00000606		
463.925	1.4835864	1.00065015	-0.00966	4'	1.00032702	0.00000431		
498.765	1.4835866	1.00065212	-0.00682	4'	1.00032772	0.00000311		
533.604	1.4835867	1.00065336	-0.00481	4'	1.00032822	0.00000225		
568.444	1.4835868	1.00065435	-0.00340	4'	1.00032856	0.00000164		
603.284	1.4835869	1.00065508	-0.00240	3'	1.00032881	0.00000121		
638.123	1.4835869	1.00065533	-0.00169	3'	1.00032898	0.00000091		
672.963	1.4835869	1.00065584	-0.00119	3'	1.00032911	0.00000069		
707.802	1.4835869	1.00065606	-0.00084	3'	1.00032920	0.00000054		
742.642	1.4835869	1.00065606	-0.00060	3'	1.00032926	0.00000043		
777.481	1.4835870	1.00065632	-0.00042	3'	1.00032930	0.00000036		
812.321	1.4835870	1.00065657	-0.00030	3'	1.00032933	0.00000031		
847.160	1.4835870	1.00065657	-0.00021	3'	1.00032935	0.00000027		
882.000	1.4835870	1.00065657	-0.00015	3'	1.00032937	0.00000024		
916.839	1.4835870	1.00065657	-0.00010	2'	1.00032938	0.00000022		
951.679	1.4835870	1.00065657	-0.00007	2'	1.00032939	0.00000021		

OMEGA 3000000 KAPPA 0.0100 DELTA 0.000010 VECTORLENGTH 0.50
ALPHA -0.00115 BETA -0.87125 GAMMA -0.87239
REFLECTIONFACTOR 0.0004690 3.1428947 TRANSITFACTOR 1.0013182 0.0000011

HEIGTH	THETA	E KELLER	ZETA		DISTORTION FUNCTION			
-1000.000	1.5271629	1.00000000	-0.00005	2'	1.00000003	0.00000002	0.00046898	3.14289468
-978.190	1.5271629	1.00000000	-0.00006	2'	1.00000003	0.00000003	0.00046898	3.14289468
-956.380	1.5271629	1.00000000	-0.00007	2'	1.00000004	0.00000004	0.00046898	3.14289469
-934.571	1.5271629	1.00000000	-0.00009	2'	1.00000005	0.00000004	0.00046898	3.14289469
-912.761	1.5271629	1.00000000	-0.00011	2'	1.00000006	0.00000005	0.00046898	3.14289471
-890.951	1.5271629	1.00000000	-0.00014	3'	1.00000008	0.00000007	0.00046898	3.14289472
-869.141	1.5271629	1.00000000	-0.00017	3'	1.00000009	0.00000008	0.00046898	3.14289474
-847.332	1.5271629	1.00000000	-0.00021	3'	1.00000012	0.00000010	0.00046898	3.14289476
-825.522	1.5271629	1.00000000	-0.00026	3'	1.00000015	0.00000013	0.00046898	3.14289478
-803.712	1.5271630	1.00000094	-0.00032	3'	1.00000019	0.00000016	0.00046898	3.14289481
-781.902	1.5271630	1.00000094	-0.00040	3'	1.00000023	0.00000020	0.00046898	3.14289485
-760.093	1.5271630	1.00000094	-0.00050	3'	1.00000029	0.00000025	0.00046898	3.14289490
-738.283	1.5271630	1.00000094	-0.00062	3'	1.00000035	0.00000031	0.00046898	3.14289496
-716.473	1.5271630	1.00000188	-0.00077	3'	1.00000044	0.00000038	0.00046898	3.14289504
-694.663	1.5271630	1.00000188	-0.00096	3'	1.00000055	0.00000048	0.00046898	3.14289513
-672.854	1.5271631	1.00000290	-0.00120	3'	1.00000068	0.00000060	0.00046898	3.14289524
-651.044	1.5271631	1.00000384	-0.00149	3'	1.00000085	0.00000074	0.00046898	3.14289539
-629.234	1.5271631	1.00000487	-0.00185	3'	1.00000105	0.00000092	0.00046898	3.14289557
-607.424	1.5271632	1.00000580	-0.00230	3'	1.00000130	0.00000114	0.00046898	3.14289580
-585.615	1.5271632	1.00000683	-0.00286	4'	1.00000162	0.00000142	0.00046898	3.14289607
-563.805	1.5271634	1.00000973	-0.00356	4'	1.00000202	0.00000177	0.00046898	3.14289641
-541.996	1.5271634	1.00001170	-0.00443	4'	1.00000251	0.00000219	0.00046898	3.14289685
-520.186	1.5271636	1.00001460	-0.00551	4'	1.00000312	0.00000273	0.00046898	3.14289737
-498.377	1.5271637	1.00001853	-0.00685	4'	1.00000388	0.00000339	0.00046898	3.14289804
-476.567	1.5271639	1.00002245	-0.00852	4'	1.00000482	0.00000421	0.00046898	3.14289887
-454.758	1.5271642	1.00002835	-0.01059	4'	1.00000599	0.00000524	0.00046898	3.14289989
-432.949	1.5271645	1.00003519	-0.01317	5'	1.00000744	0.00000651	0.00046898	3.14290116
-411.140	1.5271643	1.00004304	-0.01638	5'	1.00000925	0.00000809	0.00046899	3.14290275
-389.331	1.5271652	1.00005287	-0.02038	5'	1.00001148	0.00001006	0.00046899	3.14290471
-367.522	1.5271658	1.00006457	-0.02534	5'	1.00001425	0.00001249	0.00046899	3.14290715
-345.714	1.5271664	1.00008019	-0.03152	6'	1.00001769	0.00001553	0.00046899	3.14291018
-323.906	1.5271672	1.00009882	-0.03920	6'	1.00002195	0.00001928	0.00046899	3.14291393
-302.098	1.5271682	1.00012137	-0.04875	6'	1.00002720	0.00002394	0.00046899	3.14291859
-280.291	1.5271695	1.00014973	-0.06063	7'	1.00003368	0.00002971	0.00046900	3.14292436
-258.485	1.5271710	1.00018407	-0.07541	7'	1.00004167	0.00003684	0.00046900	3.14293150
-236.679	1.5271728	1.00022517	-0.09378	8'	1.00005149	0.00004567	0.00046901	3.14294033
-214.874	1.5271749	1.00027422	-0.11663	9'	1.00006352	0.00005657	0.00046901	3.14295123
-193.070	1.5271775	1.00033301	-0.14505	10'	1.00007823	0.00007001	0.00046902	3.14296466
-171.268	1.5271804	1.00040156	-0.18038	11'	1.00009614	0.00008653	0.00046903	3.14298119
-149.467	1.5271839	1.00048097	-0.22432	13'	1.00011784	0.00010681	0.00046904	3.14300147
-127.667	1.5271879	1.00057313	-0.27896	15'	1.00014399	0.00013163	0.00046905	3.14302628
-105.870	1.5271925	1.00067711	-0.34691	18'	1.00017530	0.00016189	0.00046906	3.14305655
-84.075	1.5271975	1.00079291	-0.43139	22'	1.00021250	0.00019865	0.00046908	3.14309330
-62.283	1.5272029	1.00091756	-0.53643	29'	1.00025633	0.00024309	0.00046910	3.14313775
-40.493	1.5272088	1.00105302	-0.66702	45'	1.00030746	0.00029654	0.00046913	3.14319119
-18.706	1.5272149	1.00119255	-0.82939	97'	1.00036647	0.00036043	0.00046915	3.14325508
3.078	1.5272211	1.00133502	-0.96969	× 316'	1.00096083	0.00041467		
24.859	1.5272273	1.00147856	-0.77990	73'	1.00096797	0.00034238		
46.636	1.5272334	1.00161717	-0.62728	39'	1.00102487	0.00028159		
68.411	1.5272391	1.00174999	-0.50454	27'	1.00107402	0.00023083		
90.182	1.5272444	1.00187205	-0.40583	20'	1.00111604	0.00018871		
111.952	1.5272493	1.00198436	-0.32644	17'	1.00115160	0.00015392		
133.718	1.5272538	1.00208674	-0.26258	14'	1.00118146	0.00012531		
155.483	1.5272576	1.00217449	-0.21123	12'	1.00120635	0.00010187		
177.245	1.5272609	1.00225135	-0.16992	11'	1.00122698	0.00008274		
199.006	1.5272638	1.00231733	-0.13669	10'	1.00124398	0.00006714		
220.765	1.5272662	1.00237353	-0.10996	9'	1.00125794	0.00005448		

242.523	1.5272683	1.00242090	-0.08846	8'	1.00126936	0.00004420
264.281	1.5272700	1.00246029	-0.07116	7'	1.00127866	0.00003588
286.037	1.5272714	1.00249290	-0.05725	7'	1.00128623	0.00002915
307.792	1.5272726	1.00251951	-0.04605	6'	1.00129237	0.00002371
329.547	1.5272735	1.00254123	-0.03705	6'	1.00129736	0.00001932
351.302	1.5272743	1.00255900	-0.02981	6'	1.00130139	0.00001577
373.056	1.5272749	1.00257377	-0.02398	5'	1.00130464	0.00001292
394.810	1.5272754	1.00258561	-0.01929	5'	1.00130727	0.00001062
416.564	1.5272759	1.00259548	-0.01552	5'	1.00130939	0.00000876
438.317	1.5272762	1.00260338	-0.01249	5'	1.00131110	0.00000726
460.070	1.5272765	1.00260931	-0.01004	4'	1.00131248	0.00000606
481.823	1.5272767	1.00261420	-0.00808	4'	1.00131360	0.00000509
503.576	1.5272769	1.00261918	-0.00650	4'	1.00131449	0.00000431
525.329	1.5272770	1.00262210	-0.00523	4'	1.00131521	0.00000368
547.082	1.5272771	1.00262510	-0.00421	4'	1.00131579	0.00000317
568.835	1.5272772	1.00262707	-0.00339	4'	1.00131626	0.00000277
590.587	1.5272773	1.00262905	-0.00272	4'	1.00131663	0.00000244
612.340	1.5272774	1.00263000	-0.00219	3'	1.00131694	0.00000218
634.093	1.5272774	1.00263103	-0.00176	3'	1.00131718	0.00000197
655.845	1.5272774	1.00263197	-0.00142	3'	1.00131738	0.00000180
677.598	1.5272775	1.00263300	-0.00114	3'	1.00131754	0.00000166
699.350	1.5272775	1.00263394	-0.00092	3'	1.00131766	0.00000155
721.103	1.5272775	1.00263394	-0.00074	3'	1.00131777	0.00000146
742.855	1.5272775	1.00263394	-0.00059	3'	1.00131785	0.00000139
764.608	1.5272776	1.00263497	-0.00048	3'	1.00131791	0.00000133
786.360	1.5272776	1.00263497	-0.00038	3'	1.00131797	0.00000129
808.113	1.5272776	1.00263592	-0.00031	3'	1.00131801	0.00000125
829.865	1.5272776	1.00263592	-0.00025	3'	1.00131804	0.00000122
851.618	1.5272776	1.00263592	-0.00020	3'	1.00131807	0.00000119
873.370	1.5272776	1.00263592	-0.00016	3'	1.00131809	0.00000118
895.123	1.5272776	1.00263592	-0.00013	3'	1.00131811	0.00000116
916.875	1.5272776	1.00263592	-0.00010	2'	1.00131812	0.00000115
938.628	1.5272776	1.00263592	-0.00008	2'	1.00131813	0.00000114
960.380	1.5272776	1.00263592	-0.00007	2'	1.00131815	0.00000113
982.133	1.5272776	1.00263592	-0.00005	2'	1.00131815	0.00000113
1003.885	1.5272776	1.00263592	-0.00004	2'	1.00131816	0.00000112

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OMEGA 30000000 KAPPA 0.0100 DELTA 0.000100 VECTORLENGTH 0.40
REFLECTIONFACTOR 0 3.1489087 TRANSITFACTOR 1.0002139 0.0000003
ALPHA -0.00146 BETA -6.83928 GAMMA -6.84075

HEIGTH	THETA	E KELLER	ZETA	DISTORTION FUNCTION				
-1000.000	1.2217305	1.00000000	-0.00005	2'	1.00000001	0.00000007	0	0
-931.596	1.2217305	1.00000002	-0.00009	2'	1.00000002	0.00000013	0	0
-863.192	1.2217305	1.00000005	-0.00018	3'	1.00000004	0.00000025	0	0
-794.788	1.2217305	1.00000011	-0.00035	3'	1.00000007	0.00000051	0	0
-726.384	1.2217306	1.00000025	-0.00070	3'	1.00000015	0.00000100	0	0
-657.980	1.2217307	1.00000054	-0.00139	3'	1.00000029	0.00000198	0	0
-589.576	1.2217308	1.00000107	-0.00275	4'	1.00000058	0.00000393	0	0
-521.172	1.2217312	1.00000215	-0.00545	4'	1.00000114	0.00000779	0	0
-452.768	1.2217319	1.00000428	-0.01081	4'	1.00000224	0.00001539	0	0
-384.364	1.2217333	1.00000840	-0.02142	5'	1.00000439	0.00003035	0	0
-315.961	1.2217361	1.00001636	-0.04244	6'	1.00000854	0.00005956	0	0
-247.558	1.2217411	1.00003119	-0.08411	8'	1.00001631	0.00011586	0	0
-179.156	1.2217501	1.00005747	-0.16670	11'	1.00003013	0.00022159	0	0
-110.755	1.2217646	1.00009990	-0.33037	17'	1.00005263	0.00041145	0	0
-42.358	1.2217848	1.00015922	-0.65470	43'	1.00008432	0.00072870	0	0
26.036	1.2218080	1.00022730	-0.77077	70'	1.00012098	0.00082819		
94.425	1.2218294	1.00028981	-0.38897	20'	1.00015442	0.00047449		
162.811	1.2218453	1.00033652	-0.19630	12'	1.00017923	0.00025817		
231.193	1.2218555	1.00036631	-0.09907	8'	1.00019492	0.00013594		
299.574	1.2218613	1.00038344	-0.05000	7'	1.00020390	0.00007028		
367.953	1.2218645	1.00039270	-0.02523	5'	1.00020874	0.00003604		
436.332	1.2218661	1.00039756	-0.01274	5'	1.00021126	0.00001846		
504.711	1.2218670	1.00040006	-0.00643	4'	1.00021256	0.00000951		
573.089	1.2218674	1.00040133	-0.00324	4'	1.00021322	0.00000497		
641.467	1.2218676	1.00040196	-0.00164	3'	1.00021356	0.00000267		
709.846	1.2218677	1.00040231	-0.00083	3'	1.00021372	0.00000151		
778.224	1.2218678	1.00040247	-0.00042	3'	1.00021381	0.00000092		
846.602	1.2218678	1.00040254	-0.00021	3'	1.00021385	0.00000063		
914.980	1.2218678	1.00040257	-0.00011	2'	1.00021387	0.00000048		
983.359	1.2218678	1.00040261	-0.00005	2'	1.00021388	0.00000040		
1051.737	1.2218679	1.00040264	-0.00003	2'	1.00021389	0.00000037		

OMEGA 3000000 KAPPA 0.0100 DELTA 0.000100 VECTORLENGTH 0.40
ALPHA -0.00576 BETA -1.73745 GAMMA -1.74320
REFLECTIONFACTOR 0.0001541 3.1549447 TRANSITFACTOR 1.0033181 0.0000179

HEIGTH	THETA	E KELLER	ZETA		DISTORTION FUNCTION			
-1000.000	1.4835298	1.00000000	-0.00005	2'	1.00000011	0.00000019	0.00015409	3.15494184
-965.138	1.4835298	1.00000000	-0.00006	2'	1.00000016	0.00000028	0.00015409	3.15494493
-930.275	1.4835298	1.00000021	-0.00009	2'	1.00000023	0.00000039	0.00015409	3.15494504
-895.413	1.4835298	1.00000047	-0.00013	3'	1.00000032	0.00000056	0.00015409	3.15494520
-860.551	1.4835299	1.00000072	-0.00019	3'	1.00000045	0.00000079	0.00015409	3.15494544
-825.688	1.4835299	1.00000145	-0.00026	3'	1.00000064	0.00000112	0.00015409	3.15494577
-790.826	1.4835300	1.00000218	-0.00037	3'	1.00000091	0.00000159	0.00015409	3.15494624
-755.964	1.4835301	1.00000316	-0.00052	3'	1.00000129	0.00000225	0.00015409	3.15494689
-721.102	1.4835302	1.00000465	-0.00074	3'	1.00000183	0.00000319	0.00015409	3.15494783
-686.240	1.4835304	1.00000684	-0.00105	3'	1.00000259	0.00000452	0.00015409	3.15494917
-651.377	1.4835306	1.00000953	-0.00148	3'	1.00000367	0.00000640	0.00015409	3.15495104
-616.515	1.4835310	1.00001346	-0.00210	3'	1.00000520	0.00000907	0.00015409	3.15495371
-581.654	1.4835315	1.00001910	-0.00298	4'	1.00000736	0.00001284	0.00015409	3.15495749
-546.792	1.4835322	1.00002719	-0.00422	4'	1.00001042	0.00001819	0.00015409	3.15496284
-511.931	1.4835332	1.00003872	-0.00598	4'	1.00001475	0.00002576	0.00015409	3.15497041
-477.070	1.4835346	1.00005492	-0.00847	4'	1.00002098	0.00003649	0.00015409	3.15498114
-442.209	1.4835366	1.00007749	-0.01201	5'	1.00002953	0.00005165	0.00015409	3.15499631
-407.350	1.4835394	1.00010960	-0.01702	5'	1.00004173	0.00007310	0.00015409	3.15501774
-372.491	1.4835432	1.00015424	-0.02412	5'	1.00005090	0.00010337	0.00015410	3.15504802
-337.634	1.4835487	1.00021632	-0.03417	6'	1.00008299	0.00014607	0.00015410	3.15509071
-302.779	1.4835562	1.00030270	-0.04842	6'	1.00011667	0.00020615	0.00015411	3.15515079
-267.927	1.4835665	1.00042102	-0.06861	7'	1.00016349	0.00029046	0.00015411	3.15523511
-233.080	1.4835804	1.00058138	-0.09722	8'	1.00022807	0.00040832	0.00015412	3.15535296
-198.238	1.4835990	1.00079441	-0.13774	10'	1.00031622	0.00057219	0.00015414	3.15551683
-180.820	1.4836103	1.00092174	-0.16395	10'	1.00037125	0.00067630	0.00015414	3.15562094
-163.405	1.4836231	1.00107203	-0.19514	12'	1.00043481	0.00079834	0.00015415	3.15574299
-145.993	1.4836376	1.00123787	-0.23225	13'	1.00050785	0.00094105	0.00015417	3.15588570
-128.583	1.4836536	1.00142280	-0.27642	15'	1.00059129	0.00110743	0.00015418	3.15605208
-111.176	1.4836714	1.00162674	-0.32898	17'	1.00068597	0.00130073	0.00015419	3.15624538
-93.773	1.4836907	1.00184957	-0.39151	20'	1.00079256	0.00152445	0.00015421	3.15646909
-76.374	1.4837116	1.00209030	-0.46592	24'	1.00091153	0.00178222	0.00015423	3.15672687
-58.979	1.4837339	1.00234678	-0.55444	31'	1.00104299	0.00207781	0.00015425	3.15702246
-41.589	1.4837573	1.00261654	-0.65975	44'	1.00118668	0.00241491	0.00015427	3.15735956
-24.203	1.4837815	1.00289590	-0.78503	75'	1.00134175	0.00279705	0.00015429	3.15774170
-6.822	1.4838062	1.00318148	-0.93405	265'	1.00150680	0.00322744	0.00015432	3.15817209
10.554	1.4838311	1.00346899	-0.89984	171'	1.00183218	0.00316217		
27.925	1.4838558	1.00375404	-0.75635	65'	1.00199632	0.00274061		
45.291	1.4838798	1.00403239	-0.63577	40'	1.00215012	0.00236705		
62.653	1.4839030	1.00430030	-0.53444	29'	1.00229224	0.00203811		
80.010	1.4839250	1.00455172	-0.44929	23'	1.00242205	0.00175012		
97.362	1.4839456	1.00479343	-0.37771	19'	1.00253929	0.00149930		
114.710	1.4839646	1.00501364	-0.31756	16'	1.00264419	0.00128186		
132.055	1.4839820	1.00521534	-0.26699	14'	1.00273723	0.00109416		
149.396	1.4839977	1.00539794	-0.22448	13'	1.00281916	0.00093269		
166.734	1.4840119	1.00556171	-0.18875	11'	1.00289082	0.00079424		
184.069	1.4840244	1.00570708	-0.15871	10'	1.00295316	0.00067587		
201.402	1.4840354	1.00583532	-0.13345	9'	1.00300711	0.00057490		
218.732	1.4840451	1.00594785	-0.11222	9'	1.00305361	0.00048896		
236.061	1.4840536	1.00604574	-0.09436	8'	1.00309354	0.00041594		
253.387	1.4840609	1.00613062	-0.07935	8'	1.00312771	0.00035400		
270.713	1.4840672	1.00620379	-0.06673	7'	1.00315689	0.00030152		
288.037	1.4840726	1.00626676	-0.05611	7'	1.00318173	0.00025711		
305.360	1.4840772	1.00632073	-0.04719	6'	1.00320286	0.00021957		
322.682	1.4840812	1.00636670	-0.03968	6'	1.00322079	0.00018785		
340.003	1.4840846	1.00640596	-0.03337	6'	1.00323598	0.00016107		
357.324	1.4840874	1.00643944	-0.02806	6'	1.00324883	0.00013849		
374.644	1.4840899	1.00646770	-0.02260	5'	1.00325970	0.00011944		

391.963	1.4840920	1.00649195	-0.01985	5'	1.00326889	0.00010338
409.283	1.4840937	1.00651217	-0.01669	5'	1.00327665	0.00008986
426.601	1.4840952	1.00652919	-0.01404	5'	1.00328320	0.00007846
443.920	1.4840964	1.00654396	-0.01181	5'	1.00328871	0.00006287
461.238	1.4840975	1.00655621	-0.00993	4'	1.00329336	0.00006079
478.556	1.4840984	1.00656669	-0.00835	4'	1.00329738	0.00005399
495.874	1.4840991	1.00657544	-0.00702	4'	1.00330058	0.00004826
513.192	1.4840998	1.00658271	-0.00591	4'	1.00330336	0.00004344
530.509	1.4841003	1.00658869	-0.00497	4'	1.00330570	0.00003939
547.827	1.4841007	1.00659398	-0.00418	4'	1.00330768	0.00003598
565.144	1.4841011	1.00659848	-0.00351	4'	1.00330934	0.00003311
582.462	1.4841015	1.00660220	-0.00295	4'	1.00331073	0.00003070
599.779	1.4841017	1.00660545	-0.00248	4'	1.00331191	0.00002866
617.096	1.4841019	1.00660796	-0.00209	3'	1.00331289	0.00002696
634.413	1.4841021	1.00661021	-0.00176	3'	1.00331373	0.00002552
651.730	1.4841023	1.00661195	-0.00148	3'	1.00331443	0.00002431
669.048	1.4841024	1.00661372	-0.00124	3'	1.00331502	0.00002330
686.365	1.4841026	1.00661498	-0.00105	3'	1.00331551	0.00002244
703.682	1.4841026	1.00661597	-0.00088	3'	1.00331593	0.00002172
720.999	1.4841027	1.00661697	-0.00074	3'	1.00331628	0.00002111
738.316	1.4841028	1.00661771	-0.00062	3'	1.00331657	0.00002061
755.633	1.4841029	1.00661849	-0.00052	3'	1.00331682	0.00002018
772.950	1.4841029	1.00661896	-0.00044	3'	1.00331703	0.00001982
790.267	1.4841029	1.00661949	-0.00037	3'	1.00331721	0.00001951
807.584	1.4841030	1.00661996	-0.00031	3'	1.00331735	0.00001926
824.901	1.4841030	1.00662022	-0.00026	3'	1.00331748	0.00001904
842.218	1.4841030	1.00662048	-0.00022	3'	1.00331758	0.00001886
859.534	1.4841030	1.00662069	-0.00018	3'	1.00331767	0.00001872
876.851	1.4841031	1.00662095	-0.00015	3'	1.00331774	0.00001859
894.168	1.4841031	1.00662095	-0.00013	3'	1.00331780	0.00001848
911.485	1.4841031	1.00662121	-0.00011	2'	1.00331786	0.00001839
928.802	1.4841031	1.00662147	-0.00009	2'	1.00331790	0.00001831
946.119	1.4841031	1.00662147	-0.00008	2'	1.00331794	0.00001825
963.436	1.4841031	1.00662147	-0.00007	2'	1.00331796	0.00001820
980.753	1.4841031	1.00662173	-0.00006	2'	1.00331799	0.00001815
998.070	1.4841031	1.00662173	-0.00005	2'	1.00331801	0.00001811
1015.387	1.4841031	1.00662173	-0.00004	2'	1.00331803	0.00001808

OMEGA 3000000 KAPPA 0.0100 DELTA 0.000100 VECTORLENGTH 0.50
ALPHA -0.01162 BETA -0.86082 GAMMA -0.87244
REFLECTIONFACTOR 0.0049072 3.1516681 TRANSITFACTOR 1.0135752 0.0001134

HEIGTH	THETA	E KELLER	ZETA		DISTORTION FUNCTION			
-1000.000	1.5271629	1.00000000	-0.00005	2'	1.00000026	0.00000022	0.00490720	3.15466827
-978.190	1.5271629	1.00000000	-0.00006	2'	1.00000032	0.00000028	0.00490720	3.15466832
-956.380	1.5271629	1.00000000	-0.00007	2'	1.00000040	0.00000035	0.00490720	3.15466839
-934.571	1.5271630	1.00000094	-0.00009	2'	1.00000050	0.00000043	0.00490720	3.15466848
-912.761	1.5271630	1.00000094	-0.00011	2'	1.00000062	0.00000054	0.00490720	3.15466858
-890.951	1.5271630	1.00000187	-0.00014	3'	1.00000077	0.00000067	0.00490720	3.15466871
-869.141	1.5271631	1.00000290	-0.00017	3'	1.00000095	0.00000083	0.00490720	3.15466888
-847.332	1.5271631	1.00000384	-0.00021	3'	1.00000118	0.00000104	0.00490720	3.15466908
-825.522	1.5271631	1.00000487	-0.00026	3'	1.00000148	0.00000129	0.00490720	3.15466933
-803.712	1.5271632	1.00000683	-0.00032	3'	1.00000183	0.00000160	0.00490720	3.15466964
-781.903	1.5271634	1.00000973	-0.00040	3'	1.00000228	0.00000199	0.00490721	3.15467004
-760.093	1.5271635	1.00001272	-0.00050	3'	1.00000284	0.00000247	0.00490721	3.15467052
-738.284	1.5271636	1.00001563	-0.00062	3'	1.00000353	0.00000308	0.00490721	3.15467113
-716.474	1.5271638	1.00001955	-0.00077	3'	1.00000439	0.00000383	0.00490722	3.15467188
-694.665	1.5271640	1.00002442	-0.00096	3'	1.00000546	0.00000476	0.00490722	3.15467281
-672.856	1.5271643	1.00003126	-0.00120	3'	1.00000679	0.00000592	0.00490723	3.15467397
-651.047	1.5271646	1.00003715	-0.00149	3'	1.00000845	0.00000737	0.00490724	3.15467542
-629.238	1.5271650	1.00004697	-0.00185	3'	1.00001050	0.00000916	0.00490725	3.15467720
-607.429	1.5271655	1.00005867	-0.00230	3'	1.00001306	0.00001139	0.00490726	3.15467944
-585.620	1.5271661	1.00007336	-0.00286	4'	1.00001623	0.00001417	0.00490728	3.15468222
-563.812	1.5271669	1.00009198	-0.00356	4'	1.00002019	0.00001762	0.00490729	3.15468567
-542.004	1.5271679	1.00011454	-0.00443	4'	1.00002510	0.00002191	0.00490732	3.15468996
-520.197	1.5271691	1.00014196	-0.00551	4'	1.00003120	0.00002725	0.00490735	3.15469529
-498.390	1.5271707	1.00017716	-0.00685	4'	1.00003878	0.00003388	0.00490739	3.15470192
-476.585	1.5271725	1.00022030	-0.00852	4'	1.00004821	0.00004212	0.00490743	3.15471017
-454.780	1.5271749	1.00027422	-0.01059	4'	1.00005990	0.00005236	0.00490749	3.15472040
-432.976	1.5271778	1.00033985	-0.01317	5'	1.00007442	0.00006509	0.00490756	3.15473313
-411.173	1.5271813	1.00042215	-0.01638	5'	1.00009245	0.00008089	0.00490765	3.15474894
-389.373	1.5271857	1.00052311	-0.02037	5'	1.00011481	0.00010052	0.00490776	3.15476856
-367.574	1.5271912	1.00064863	-0.02533	5'	1.00014251	0.00012489	0.00490790	3.15479293
-345.779	1.5271978	1.00080070	-0.03150	6'	1.00017682	0.00015513	0.00490806	3.15482318
-323.986	1.5272060	1.00098918	-0.03917	6'	1.00021928	0.00019263	0.00490827	3.15486068
-302.198	1.5272161	1.00122003	-0.04870	6'	1.00027173	0.00023910	0.00490853	3.15490715
-280.415	1.5272283	1.00150117	-0.06056	7'	1.00033644	0.00029665	0.00490885	3.15496470
-258.638	1.5272431	1.00184153	-0.07529	7'	1.00041614	0.00036784	0.00490924	3.15503589
-236.868	1.5272610	1.00225332	-0.09360	8'	1.00051406	0.00045580	0.00490972	3.15512384
-215.107	1.5272824	1.00274643	-0.11636	9'	1.00063403	0.00056430	0.00491031	3.15523235
-193.357	1.5273078	1.00333225	-0.14463	10'	1.00078054	0.00069791	0.00491103	3.15536596
-171.620	1.5273377	1.00402215	-0.17975	11'	1.00095874	0.00086208	0.00491190	3.15553012
-149.897	1.5273725	1.00482673	-0.22336	13'	1.00117447	0.00106324	0.00491296	3.15573129
-128.192	1.5274123	1.00574963	-0.27750	15'	1.00143417	0.00130900	0.00491423	3.15597705
-106.507	1.5274574	1.00679706	-0.34470	17'	1.00174474	0.00160813	0.00491576	3.15627618
-84.844	1.5275075	1.00796198	-0.42808	22'	1.00211336	0.00197009	0.00491757	3.15663873
-63.207	1.5275621	1.00923553	-0.53149	29'	1.00254712	0.00240796	0.00491970	3.15707600
-41.596	1.5276204	1.01059882	-0.65970	44'	1.00305262	0.00293244	0.00492218	3.15760049
-20.015	1.5276814	1.01202956	-0.81861	90'	1.00363531	0.00355765	0.00492504	3.15822570
1.536	1.5277437	1.01349391	-0.98476	- 316'	1.01711072	0.00422364		
23.055	1.5278059	1.01496058	-0.79409	79'	1.00990001	0.00357960		
44.544	1.5278666	1.01639549	-0.64054	41'	1.01048869	0.00296909		
66.002	1.5279245	1.01776847	-0.51684	28'	1.01099792	0.00245894		
87.432	1.5279785	1.01905371	-0.41715	21'	1.01143395	0.00203491		
108.834	1.5280281	1.02023472	-0.33678	17'	1.01180401	0.00168403		
130.212	1.5280727	1.02129980	-0.27196	14'	1.01211565	0.00139482		
151.567	1.5281121	1.02224278	-0.21966	12'	1.01237632	0.00115722		
172.903	1.5281465	1.02306885	-0.17746	11'	1.01259311	0.00096257		
194.221	1.5281762	1.02378142	-0.14339	10'	1.01277253	0.00080347		
215.525	1.5282015	1.02439010	-0.11587	9'	1.01292042	0.00067368		

236.816	1.5282228	1.0249o298	-0.09365	8'	1.01304191	0.00056797
258.096	1.5282408	1.02533538	-0.07570	7'	1.01314142	0.00048199
279.367	1.5282556	1.02569428	-0.06120	7'	1.01322274	0.00041212
300.631	1.5282680	1.02599338	-0.04947	6'	1.01328907	0.00035541
321.889	1.5282783	1.02623985	-0.04000	6'	1.01334308	0.00030940
343.142	1.5282866	1.02644200	-0.03234	6'	1.01338702	0.00027210
364.390	1.5282935	1.02660821	-0.02615	5'	1.01342271	0.00024187
385.635	1.5282991	1.02674378	-0.02115	5'	1.01345168	0.00021738
406.877	1.5283037	1.02685399	-0.01710	5'	1.01347517	0.00019754
428.117	1.5283074	1.02694414	-0.01383	5'	1.01349423	0.00018150
449.355	1.5283104	1.02701728	-0.01118	5'	1.01350966	0.00016849
470.592	1.5283129	1.02707665	-0.00904	4'	1.01352217	0.00015798
491.827	1.5283149	1.02712548	-0.00731	4'	1.01353230	0.00014947
513.061	1.5283165	1.02716467	-0.00591	4'	1.01354050	0.00014259
534.295	1.5283178	1.02719657	-0.00478	4'	1.01354713	0.00013702
555.528	1.5283189	1.02722306	-0.00387	4'	1.01355250	0.00013251
576.760	1.5283198	1.02724325	-0.00313	4'	1.01355685	0.00012887
597.992	1.5283205	1.02726019	-0.00253	4'	1.01356036	0.00012591
619.224	1.5283210	1.02727398	-0.00205	3'	1.01356320	0.00012353
640.455	1.5283215	1.02728570	-0.00165	3'	1.01356550	0.00012160
661.686	1.5283219	1.02729417	-0.00134	3'	1.01356737	0.00012004
682.917	1.5283222	1.02730156	-0.00108	3'	1.01356887	0.00011878
704.147	1.5283224	1.02730796	-0.00087	3'	1.01357009	0.00011776
725.378	1.5283226	1.02731219	-0.00071	3'	1.01357108	0.00011693
746.608	1.5283228	1.02731643	-0.00057	3'	1.01357187	0.00011627
767.839	1.5283229	1.02731967	-0.00046	3'	1.01357252	0.00011572
789.069	1.5283230	1.02732175	-0.00037	3'	1.01357304	0.00011529
810.299	1.5283231	1.02732391	-0.00030	3'	1.01357346	0.00011493
831.530	1.5283231	1.02732490	-0.00024	3'	1.01357380	0.00011465
852.760	1.5283232	1.02732707	-0.00020	3'	1.01357407	0.00011442
873.990	1.5283233	1.02732815	-0.00016	3'	1.01357429	0.00011423
895.220	1.5283233	1.02732923	-0.00013	3'	1.01357448	0.00011408
916.450	1.5283233	1.02732923	-0.00010	2'	1.01357463	0.00011396
937.680	1.5283234	1.02733022	-0.00008	2'	1.01357475	0.00011386
958.910	1.5283234	1.02733022	-0.00007	2'	1.01357483	0.00011378
980.141	1.5283234	1.02733130	-0.00006	2'	1.01357491	0.00011372
1001.371	1.5283234	1.02733130	-0.00004	2'	1.01357497	0.00011367

OMEGA 30000000 KAPPA 0.0100 DELTA 0.001000 VECTORLENGTH 0.40
REFLECTIONFACTOR 0 3.2148429 TRANSITFACTOR 1.0021465 0.0000313
ALPHA -0.01464 BETA -6.82918 GAMMA -6.84382 1982 NOV 19 15:13

HEIGTH	THETA	E KELLER	ZETA		DISTORTION FUNCTION			
-1000.000	1.2217305	1.00000000	-0.00005	2'	1.00000010	0.00000065	0	0
-931.596	1.2217305	1.00000018	-0.00009	2'	1.00000019	0.00000129	0	0
-863.192	1.2217306	1.00000051	-0.00018	3'	1.00000037	0.00000255	0	0
-794.788	1.2217309	1.00000121	-0.00035	3'	1.00000074	0.00000505	0	0
-726.384	1.2217314	1.00000262	-0.00070	3'	1.00000146	0.00001001	0	0
-657.980	1.2217323	1.00000539	-0.00139	3'	1.00000290	0.00001985	0	0
-589.576	1.2217342	1.00001083	-0.00275	4'	1.00000573	0.00003931	0	0
-521.173	1.2217378	1.00002160	-0.00545	4'	1.00001134	0.00007780	0	0
-452.770	1.2217451	1.00004277	-0.01081	4'	1.00002236	0.00015381	0	0
-384.369	1.2217592	1.00008409	-0.02141	5'	1.00004389	0.00030332	0	0
-315.971	1.2217863	1.00016351	-0.04244	6'	1.00008532	0.00059533	0	0
-247.577	1.2218369	1.00031182	-0.08410	8'	1.00016294	0.00115791	0	0
-179.193	1.2219265	1.00057457	-0.16664	11'	1.00030115	0.00221438	0	0
-110.826	1.2220712	1.00099924	-0.33013	17'	1.00052617	0.00411107	0	0
-42.486	1.2222735	1.00159335	-0.65386	43'	1.00084344	0.00727908	0	0
25.816	1.2225058	1.00227636	-0.77247	70'	1.00120970	0.00834821		
94.074	1.2227194	1.00290502	-0.39034	20'	1.00154575	0.00480185		
162.293	1.2228791	1.00337591	-0.19732	12'	1.00179549	0.00263031		
230.481	1.2229813	1.00367713	-0.09978	8'	1.00195394	0.00140113		
298.650	1.2230401	1.00385085	-0.05046	7'	1.00204476	0.00073955		
366.807	1.2230721	1.00394510	-0.02553	5'	1.00209385	0.00039369		
434.959	1.2230888	1.00399455	-0.01291	5'	1.00211955	0.00021572		
503.108	1.2230974	1.00402004	-0.00653	4'	1.00213279	0.00012489		
571.255	1.2231019	1.00403305	-0.00330	4'	1.00213955	0.00007875		
639.401	1.2231041	1.00403967	-0.00167	3'	1.00214297	0.00005534		
707.547	1.2231052	1.00404303	-0.00085	3'	1.00214472	0.00004349		
775.693	1.2231058	1.00404472	-0.00043	3'	1.00214560	0.00003749		
843.838	1.2231061	1.00404559	-0.00022	3'	1.00214604	0.00003446		
911.984	1.2231062	1.00404603	-0.00011	2'	1.00214627	0.00003292		
980.129	1.2231063	1.00404624	-0.00006	2'	1.00214639	0.00003214		
1048.274	1.2231064	1.00404635	-0.00003	2'	1.00214644	0.00003175		

OMEGA 30000000 KAPPA 0.0100 DELTA 0.001000 VECTORLENGTH 0.40
ALPHA -0.05936 BETA -1.69463 GAMMA -1.74399
REFLECTIONFACTOR 0.0018868 3.2774495 TRANSITFACTOR 1.0358776 0.0019568

HEIGTH	THETA	E KELLER	ZETA		DISTORTION FUNCTION			
-1000.000	1.4835298	1.00000000	-0.00005	2'	1.00000113	0.00000196	0.00188681	3.27745143
-982.569	1.4835298	1.00000047	-0.00005	2'	1.00000134	0.00000233	0.00188681	3.27745180
-965.138	1.4835299	1.00000145	-0.00006	2'	1.00000159	0.00000278	0.00188681	3.27745225
-947.707	1.4835300	1.00000218	-0.00008	2'	1.00000190	0.00000331	0.00188681	3.27745277
-930.275	1.4835301	1.00000316	-0.00009	2'	1.00000226	0.00000393	0.00188682	3.27745340
-912.844	1.4835302	1.00000439	-0.00011	2'	1.00000268	0.00000469	0.00188682	3.27745415
-895.413	1.4835303	1.00000564	-0.00013	3'	1.00000320	0.00000557	0.00188682	3.27745505
-877.982	1.4835304	1.00000735	-0.00015	3'	1.00000381	0.00000664	0.00188682	3.27745610
-860.551	1.4835306	1.00000931	-0.00018	3'	1.00000453	0.00000790	0.00188682	3.27745737
-843.120	1.4835308	1.00001149	-0.00022	3'	1.00000539	0.00000940	0.00188682	3.27745888
-825.689	1.4835310	1.00001397	-0.00026	3'	1.00000642	0.00001120	0.00188682	3.27746066
-808.258	1.4835313	1.00001713	-0.00031	3'	1.00000764	0.00001333	0.00188683	3.27746280
-790.827	1.4835316	1.00002107	-0.00037	3'	1.00000910	0.00001586	0.00188683	3.27746534
-773.397	1.4835320	1.00002573	-0.00044	3'	1.00001083	0.00001889	0.00188683	3.27746835
-755.966	1.4835325	1.00003111	-0.00052	3'	1.00001289	0.00002248	0.00188684	3.27747195
-738.535	1.4835331	1.00003773	-0.00062	3'	1.00001534	0.00002676	0.00188684	3.27747623
-721.105	1.4835338	1.00004560	-0.00074	3'	1.00001826	0.00003186	0.00188685	3.27748132
-703.674	1.4835346	1.00005466	-0.00088	3'	1.00002174	0.00003792	0.00188685	3.27748739
-686.244	1.4835355	1.00006569	-0.00105	3'	1.00002588	0.00004514	0.00188686	3.27749461
-668.814	1.4835366	1.00007843	-0.00125	3'	1.00003080	0.00005373	0.00188687	3.27750320
-651.384	1.4835380	1.00009416	-0.00148	3'	1.00003666	0.00006396	0.00188688	3.27751342
-633.955	1.4835396	1.00011281	-0.00177	3'	1.00004363	0.00007613	0.00188689	3.27752560
-616.526	1.4835415	1.00013439	-0.00210	3'	1.00005193	0.00009061	0.00188691	3.27754008
-599.097	1.4835438	1.00016039	-0.00250	4'	1.00006180	0.00010785	0.00188693	3.27755732
-581.668	1.4835465	1.00019156	-0.00298	4'	1.00007355	0.00012837	0.00188695	3.27757784
-564.241	1.4835497	1.00022859	-0.00354	4'	1.00008753	0.00015279	0.00188698	3.27760226
-546.813	1.4835535	1.00027226	-0.00422	4'	1.00010416	0.00018184	0.00188701	3.27763131
-529.387	1.4835581	1.00032477	-0.00502	4'	1.00012393	0.00021641	0.00188704	3.27766588
-511.961	1.4835635	1.00038667	-0.00598	4'	1.00014744	0.00025753	0.00188709	3.27770700
-494.537	1.4835699	1.00046029	-0.00712	4'	1.00017540	0.00030645	0.00188714	3.27775592
-477.114	1.4835775	1.00054775	-0.00847	4'	1.00020863	0.00036463	0.00188720	3.27781411
-459.692	1.4835866	1.00065165	-0.01008	4'	1.00024812	0.00043382	0.00188728	3.27788329
-442.272	1.4835973	1.00077501	-0.01200	5'	1.00029503	0.00051609	0.00188737	3.27796556
-424.855	1.4836100	1.00092101	-0.01428	5'	1.00035073	0.00061388	0.00188747	3.27806335
-407.439	1.4836250	1.00109392	-0.01700	5'	1.00041685	0.00073010	0.00188760	3.27817956
-390.027	1.4836429	1.00129893	-0.02024	5'	1.00049527	0.00086815	0.00188775	3.27831762
-372.619	1.4836639	1.00154150	-0.02408	5'	1.00058823	0.00103210	0.00188792	3.27848157
-355.214	1.4836838	1.00182739	-0.02866	6'	1.00069834	0.00122669	0.00188813	3.27867617
-337.815	1.4837181	1.00216507	-0.03411	6'	1.00083866	0.00145756	0.00188837	3.27890703
-320.421	1.4837526	1.00256240	-0.04059	6'	1.00098269	0.00173126	0.00188867	3.27918074
-303.034	1.4837930	1.00302901	-0.04830	6'	1.00116453	0.00205553	0.00188901	3.27950500
-285.656	1.4838404	1.00357604	-0.05747	7'	1.00137889	0.00243934	0.00188941	3.27988882
-268.286	1.4838957	1.00421559	-0.06837	7'	1.00163111	0.00289318	0.00188989	3.28034265
-250.928	1.4839600	1.00496089	-0.08133	8'	1.00192726	0.00342916	0.00189045	3.28087863
-233.583	1.4840316	1.00582559	-0.09673	8'	1.00227414	0.00406125	0.00189110	3.28151073
-216.252	1.4841206	1.00682485	-0.11503	9'	1.00267927	0.00480548	0.00189187	3.28225496
-198.939	1.4842193	1.00797399	-0.13678	10'	1.00315088	0.00568005	0.00189276	3.28312953
-181.645	1.4843318	1.00928730	-0.16260	10'	1.00369776	0.00670554	0.00189379	3.28415502
-164.373	1.4844593	1.01077946	-0.19326	11'	1.00432910	0.00790495	0.00189498	3.28535442
-147.127	1.4846025	1.01246088	-0.22963	13'	1.00505427	0.00930370	0.00189635	3.28675319
-129.910	1.4847620	1.01434074	-0.27278	14'	1.00598240	0.01092961	0.00189791	3.28837909
-112.724	1.4849380	1.01642262	-0.32392	16'	1.00682190	0.01281256	0.00189968	3.29026204
-95.574	1.4851302	1.01870520	-0.38453	19'	1.00787990	0.01498418	0.00190168	3.29243367
-78.461	1.4853375	1.02117989	-0.45630	23'	1.00906153	0.01747724	0.00190391	3.29492673
-61.391	1.4855585	1.02383100	-0.54123	30'	1.01036913	0.02032486	0.00190638	3.29777435
-44.364	1.4857911	1.02663488	-0.64170	41'	1.01180143	0.02355957	0.00190908	3.30100907
-27.383	1.4860324	1.02956118	-0.76046	66'	1.01335297	0.02721215	0.00191201	3.30466165

-10.451	1.4862793	1.0325724	-0.90077	172'	1.0150132	0.03131037	0.00191514	3.30875988
6.433	1.4865285	1.0356303	-0.93770	282'	1.0186760	0.03579333		
23.266	1.4867764	1.0386889	-0.79242	78'	1.0204793	0.03138641		
40.051	1.4870195	1.0417065	-0.66998	46'	1.0221789	0.02747531		
56.786	1.4872547	1.0446428	-0.56673	32'	1.0237593	0.02402399		
73.475	1.4874793	1.0474621	-0.47962	25'	1.0252116	0.02099387		
90.119	1.4876911	1.0501354	-0.40608	21'	1.0265325	0.01834545		
106.721	1.4878886	1.0526398	-0.34397	17'	1.0277226	0.01603980		
123.284	1.4880708	1.0549603	-0.29146	15'	1.0287865	0.01403941		
139.810	1.4882372	1.0570887	-0.24707	13'	1.0297308	0.01230905		
156.303	1.4883878	1.0590231	-0.20950	12'	1.0305639	0.01081612		
172.766	1.4885230	1.0607657	-0.17770	11'	1.0312950	0.00953088		
189.202	1.4886436	1.0623241	-0.15077	10'	1.0319337	0.00842652		
205.614	1.4887504	1.0637090	-0.12795	9'	1.0324894	0.00747914		
222.005	1.4888445	1.0649315	-0.10860	9'	1.0329712	0.00666753		
238.377	1.4889270	1.0660059	-0.09220	8'	1.0333879	0.00597306		
254.733	1.4889990	1.0669453	-0.07829	8'	1.0337472	0.00537942		
271.074	1.4890616	1.0677638	-0.06649	7'	1.0340565	0.00487240		
287.403	1.4891159	1.0684740	-0.05647	7'	1.0343221	0.00443967		
303.721	1.4891628	1.0690889	-0.04797	6'	1.0345500	0.00407057		
320.029	1.4892033	1.0696194	-0.04075	6'	1.0347452	0.00375592		
336.330	1.4892381	1.0700767	-0.03462	6'	1.0349121	0.00348780		
352.623	1.4892680	1.0704692	-0.02942	6'	1.0350549	0.00325941		
368.911	1.4892936	1.0708064	-0.02499	5'	1.0351768	0.00306493		
385.194	1.4893156	1.0710954	-0.02124	5'	1.0352808	0.00289937		
401.472	1.4893344	1.0713430	-0.01805	5'	1.0353695	0.00275847		
417.746	1.4893504	1.0715543	-0.01534	5'	1.0354452	0.00263856		
434.017	1.4893641	1.0717350	-0.01303	5'	1.0355096	0.00253654		
450.286	1.4893758	1.0718892	-0.01108	5'	1.0355645	0.00244977		
466.552	1.4893858	1.0720209	-0.00941	4'	1.0356112	0.00237595		
482.816	1.4893944	1.0721332	-0.00800	4'	1.0356510	0.00231317		
499.078	1.4894016	1.0722287	-0.00680	4'	1.0356849	0.00225979		
515.339	1.4894078	1.0723102	-0.00578	4'	1.0357137	0.00221439		
531.599	1.4894130	1.0723798	-0.00491	4'	1.0357383	0.00217579		
547.858	1.4894175	1.0724387	-0.00418	4'	1.0357591	0.00214297		
564.116	1.4894213	1.0724892	-0.00355	4'	1.0357769	0.00211507		
580.373	1.4894246	1.0725318	-0.00302	4'	1.0357920	0.00209135		
596.629	1.4894273	1.0725684	-0.00256	4'	1.0358048	0.00207118		
612.885	1.4894297	1.0725989	-0.00218	3'	1.0358157	0.00205404		
629.140	1.4894317	1.0726256	-0.00185	3'	1.0358250	0.00203945		
645.395	1.4894334	1.0726480	-0.00157	3'	1.0358329	0.00202706		
661.650	1.4894348	1.0726670	-0.00134	3'	1.0358396	0.00201654		
677.904	1.4894361	1.0726834	-0.00114	3'	1.0358453	0.00200758		
694.158	1.4894371	1.0726969	-0.00097	3'	1.0358501	0.00199997		
710.412	1.4894380	1.0727087	-0.00082	3'	1.0358542	0.00199350		
726.666	1.4894387	1.0727187	-0.00070	3'	1.0358577	0.00198800		
742.919	1.4894394	1.0727272	-0.00059	3'	1.0358607	0.00198333		
759.173	1.4894399	1.0727344	-0.00050	3'	1.0358633	0.00197935		
775.426	1.4894404	1.0727405	-0.00043	3'	1.0358654	0.00197598		
791.680	1.4894408	1.0727457	-0.00036	3'	1.0358672	0.00197311		
807.933	1.4894411	1.0727502	-0.00031	3'	1.0358688	0.00197066		
824.186	1.4894414	1.0727538	-0.00026	3'	1.0358701	0.00196859		
840.439	1.4894416	1.0727572	-0.00022	3'	1.0358712	0.00196683		
856.692	1.4894419	1.0727599	-0.00019	3'	1.0358722	0.00196533		
872.945	1.4894420	1.0727623	-0.00016	3'	1.0358730	0.00196405		
889.198	1.4894422	1.0727641	-0.00014	3'	1.0358737	0.00196297		
905.451	1.4894423	1.0727659	-0.00012	2'	1.0358743	0.00196205		
921.703	1.4894424	1.0727672	-0.00010	2'	1.0358748	0.00196127		
937.956	1.4894425	1.0727683	-0.00008	2'	1.0358752	0.00196061		
954.209	1.4894426	1.0727696	-0.00007	2'	1.0358756	0.00196004		
970.462	1.4894427	1.0727705	-0.00006	2'	1.0358759	0.00195955		
986.715	1.4894427	1.0727711	-0.00005	2'	1.0358761	0.00195915		
1002.967	1.4894427	1.0727717	-0.00004	2'	1.0358763	0.00195880		

OMEGA 3000000 KAPPA 0.0100 DELTA 0.001000 VECTORLENGTH 0.50
ALPHA -0.13565 BETA -0.73719 GAMMA -0.87284
REFLECTIONFACTOR 0.0875228 3.2780971 TRANSITFACTOR 1.1999593 0.0159014

HEIGTH	THETA	E KELLER	ZETA		DISTORTION FUNCTION			
-1000.000	1.5271629	1.00000000	-0.00005	2'	1.00000258	0.00000225	0.08752299	3.27809931
-978.190	1.5271631	1.00000290	-0.00006	2'	1.00000320	0.00000279	0.08752305	3.27809986
-956.381	1.5271632	1.00000580	-0.00007	2'	1.00000399	0.00000348	0.08752312	3.27810054
-934.571	1.5271634	1.00001170	-0.00009	2'	1.00000496	0.00000433	0.08752320	3.27810139
-912.761	1.5271637	1.00001759	-0.00011	2'	1.00000617	0.00000538	0.08752331	3.27810245
-890.952	1.5271640	1.00002442	-0.00014	3'	1.00000767	0.00000669	0.08752344	3.27810376
-869.143	1.5271644	1.00003321	-0.00017	3'	1.00000954	0.00000832	0.08752360	3.27810539
-847.334	1.5271649	1.00004398	-0.00021	3'	1.00001186	0.00001035	0.08752381	3.27810742
-825.525	1.5271654	1.00005671	-0.00026	3'	1.00001475	0.00001287	0.08752406	3.27810994
-803.716	1.5271661	1.00007336	-0.00032	3'	1.00001835	0.00001601	0.08752437	3.27811307
-781.908	1.5271670	1.00009301	-0.00040	3'	1.00002281	0.00001992	0.08752477	3.27811698
-760.100	1.5271681	1.00011940	-0.00050	3'	1.00002837	0.00002477	0.08752525	3.27812183
-738.293	1.5271695	1.00015075	-0.00062	3'	1.00003528	0.00003080	0.08752586	3.27812786
-716.487	1.5271713	1.00019091	-0.00077	3'	1.00004388	0.00003830	0.08752661	3.27813537
-694.681	1.5271734	1.00023986	-0.00096	3'	1.00005457	0.00004763	0.08752754	3.27814470
-672.877	1.5271761	1.00030164	-0.00120	3'	1.00006785	0.00005924	0.08752871	3.27815630
-651.073	1.5271794	1.00037805	-0.00149	3'	1.00008438	0.00007366	0.08753015	3.27817073
-629.272	1.5271835	1.00047216	-0.00185	3'	1.00010492	0.00009160	0.08753195	3.27818867
-607.472	1.5271887	1.00059082	-0.00230	3'	1.00013046	0.00011390	0.08753419	3.27821097
-585.675	1.5271951	1.00073697	-0.00286	4'	1.00016220	0.00014163	0.08753697	3.27823869
-563.882	1.5272030	1.00091851	-0.00356	4'	1.00020165	0.00017609	0.08754042	3.27827316
-542.092	1.5272128	1.00114538	-0.00442	4'	1.00025067	0.00021892	0.08754471	3.27831598
-520.307	1.5272251	1.00142640	-0.00550	4'	1.00031158	0.00027215	0.08755004	3.27836921
-498.528	1.5272402	1.00177468	-0.00684	4'	1.00038722	0.00033827	0.08755666	3.27843533
-476.757	1.5272589	1.00220597	-0.00850	4'	1.00048113	0.00042040	0.08756488	3.27851746
-454.995	1.5272822	1.00274247	-0.01057	4'	1.00059769	0.00052238	0.08757508	3.27861945
-433.245	1.5273110	1.00340646	-0.01314	5'	1.00074228	0.00064895	0.08758774	3.27874602
-411.509	1.5273466	1.00422735	-0.01632	5'	1.00092152	0.00080597	0.08760342	3.27890304
-389.791	1.5273904	1.00524313	-0.02028	5'	1.00114355	0.00100064	0.08762286	3.27909771
-368.095	1.5274446	1.00649840	-0.02520	5'	1.00141832	0.00124183	0.08764690	3.27933890
-346.426	1.5275110	1.00804415	-0.03130	6'	1.00175[illegible]6	0.00154036	0.08767663	3.27963742
-324.790	1.5275925	1.00994472	-0.03886	6'	1.00217718	0.00190943	0.08771332	3.28000651
-303.195	1.5276919	1.01227628	-0.04822	6'	1.00269373	0.00236513	0.08775853	3.28046220
-281.649	1.5278130	1.01512847	-0.05982	7'	1.00332883	0.00292682	0.08781412	3.28102389
-260.164	1.5279595	1.01860027	-0.07415	7'	1.00410767	0.00361774	0.08788228	3.28171481
-238.753	1.5281358	1.02281211	-0.09186	8'	1.00505981	0.00446556	0.08796562	3.28256263
-217.429	1.5283464	1.02788791	-0.11369	9'	1.00621947	0.00550284	0.08806711	3.28359992
-196.210	1.5285960	1.03396828	-0.14056	10'	1.00762565	0.00676753	0.08819019	3.28486460
-175.116	1.5288887	1.04119373	-0.17357	11'	1.00932189	0.00830317	0.08833865	3.28640024
-154.169	1.5292284	1.04970310	-0.21402	12'	1.01135574	0.01015891	0.08851665	3.28825599
-133.391	1.5296173	1.05961960	-0.26345	14'	1.01377760	0.01238926	0.08872862	3.29048634
-112.807	1.5300562	1.07103852	-0.32366	16'	1.01663907	0.01505329	0.08897907	3.29315037
-92.442	1.5305438	1.08401592	-0.39676	20'	1.01999085	0.01821345	0.08927242	3.29631054
-72.322	1.5310761	1.09854817	-0.48519	25'	1.02388012	0.02193400	0.08961282	3.30003110
-52.467	1.5316470	1.11457253	-0.59175	35'	1.02834783	0.02627908	0.09000385	3.30437618
-32.897	1.5322477	1.13194445	-0.71966	55'	1.03342613	0.03131060	0.09044832	3.30940771
-13.627	1.5328681	1.15046418	-0.87260	132'	1.03913638	0.03708629	0.09094809	3.31518341
5.332	1.5334968	1.16986220	-0.94308	-316'	1.13567216	0.05401818		
23.978	1.5341226	1.18982657	-0.78680	76'	1.14455507	0.04798471		
42.310	1.5347348	1.21003115	-0.65501	43'	1.15231234	0.04293356		
60.337	1.5353243	1.23014417	-0.54696	31'	1.15904722	0.03870593		
78.069	1.5358837	1.24985871	-0.45809	24'	1.16486774	0.03516627		
95.522	1.5364076	1.26890352	-0.38473	19'	1.16988058	0.03220004		
112.713	1.5368925	1.28705825	-0.32396	17'	1.17418685	0.02971119		
129.662	1.5373371	1.30416148	-0.27345	14'	1.17787961	0.02761968		
146.388	1.5377406	1.32008596	-0.23134	13'	1.18104256	0.02585909		
162.913	1.5381043	1.33477258	-0.19610	12'	1.18374993	0.02437437		

179.256	1.5384299	1.34820196	-0.16653	11'	1.18606659	0.02312002
195.437	1.5387196	1.36038130	-0.14165	10'	1.18804884	0.02205843
211.472	1.5389762	1.37135202	-0.12067	9'	1.18974520	0.02115842
227.380	1.5392026	1.38118013	-0.10292	8'	1.19119726	0.02039419
243.174	1.5394014	1.38993067	-0.08733	8'	1.19244065	0.01974423
258.869	1.5395756	1.39768583	-0.07512	8'	1.19350574	0.01919084
274.477	1.5397279	1.40453805	-0.06426	7'	1.19441343	0.01871997
290.008	1.5398606	1.41056564	-0.05502	7'	1.19520096	0.01831619
305.474	1.5399762	1.41585447	-0.04714	6'	1.19587202	0.01797204
320.881	1.5400765	1.42047879	-0.04040	6'	1.19644773	0.01767775
336.239	1.5401636	1.42451772	-0.03465	6'	1.19694181	0.01742587
351.553	1.5402390	1.42803534	-0.02973	6'	1.19736594	0.01721016
366.829	1.5403043	1.43109404	-0.02552	5'	1.19773016	0.01702529
382.073	1.5403608	1.43375136	-0.02191	5'	1.19804299	0.01686680
397.288	1.5404096	1.43605539	-0.01882	5'	1.19831173	0.01673084
412.479	1.5404518	1.43805035	-0.01617	5'	1.19854265	0.01661416
427.649	1.5404882	1.43977894	-0.01389	5'	1.19874110	0.01651400
442.801	1.5405196	1.44127079	-0.01194	5'	1.19891167	0.01642799
457.937	1.5405467	1.44256138	-0.01026	4'	1.19905830	0.01635411
473.060	1.5405701	1.44367896	-0.00882	4'	1.19918437	0.01629064
488.170	1.5405902	1.44463967	-0.00758	4'	1.19929276	0.01623610
503.271	1.5406076	1.44547231	-0.00652	4'	1.19938597	0.01618923
518.363	1.5406225	1.44618501	-0.00561	4'	1.19946613	0.01614893
533.448	1.5406354	1.44680403	-0.00482	4'	1.19953507	0.01611429
548.526	1.5406465	1.44733774	-0.00415	4'	1.19959436	0.01608451
563.599	1.5406560	1.44779468	-0.00357	4'	1.19964536	0.01605891
578.667	1.5406642	1.44818978	-0.00307	4'	1.19968922	0.01603688
593.730	1.5406713	1.44852866	-0.00264	4'	1.19972695	0.01601794
608.791	1.5406774	1.44882325	-0.00227	3'	1.19975941	0.01600166
623.848	1.5406826	1.44907618	-0.00195	3'	1.19978733	0.01598764
638.902	1.5406872	1.44929369	-0.00168	3'	1.19981135	0.01597559
653.955	1.5406911	1.44948130	-0.00145	3'	1.19983201	0.01596523
669.005	1.5406944	1.44964224	-0.00124	3'	1.19984978	0.01595631
684.054	1.5406972	1.44977934	-0.00107	3'	1.19986507	0.01594864
699.101	1.5406997	1.44989869	-0.00092	3'	1.19987823	0.01594204
714.147	1.5407019	1.45000315	-0.00079	3'	1.19988955	0.01593637
729.192	1.5407037	1.45008969	-0.00068	3'	1.19989929	0.01593149
744.236	1.5407053	1.45016725	-0.00059	3'	1.19990767	0.01592728
759.279	1.5407067	1.45023279	-0.00050	3'	1.19991487	0.01592367
774.322	1.5407078	1.45028955	-0.00043	3'	1.19992107	0.01592056
789.364	1.5407088	1.45033732	-0.00037	3'	1.19992641	0.01591788
804.405	1.5407097	1.45037917	-0.00032	3'	1.19993100	0.01591559
819.446	1.5407104	1.45041491	-0.00028	3'	1.19993495	0.01591361
834.487	1.5407111	1.45044473	-0.00024	3'	1.19993835	0.01591190
849.527	1.5407116	1.45047167	-0.00020	3'	1.19994127	0.01591044
864.567	1.5407121	1.45049556	-0.00018	3'	1.19994378	0.01590917
879.607	1.5407125	1.45051353	-0.00015	3'	1.19994595	0.01590809
894.647	1.5407128	1.45053132	-0.00013	3'	1.19994781	0.01590715
909.686	1.5407132	1.45054622	-0.00011	2'	1.19994941	0.01590636
924.726	1.5407134	1.45055826	-0.00010	2'	1.19995079	0.01590566
939.765	1.5407137	1.45057012	-0.00008	2'	1.19995197	0.01590507
954.804	1.5407138	1.45057910	-0.00007	2'	1.19995299	0.01590456
969.843	1.5407140	1.45058808	-0.00006	2'	1.19995387	0.01590411
984.882	1.5407141	1.45059401	-0.00005	2'	1.19995463	0.01590374
999.921	1.5407143	1.45060012	-0.00005	2'	1.19995528	0.01590341
1014.959	1.5407144	1.45060605	-0.00004	2'	1.19995584	0.01590313

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OMEGA 3000000 KAPPA 0.0100 DELTA 0.010000 VECTORLENGTH 0.40
REFLECTIONFACTOR 0.0000000 3.8811854 TRANSITFACTOR 1.0223556 · 0.0032747
ALPHA -0.14868 BETA -6.72585 GAMMA -6.87453

HEIGTH	THETA	E KELLER	ZETA		DISTORTION FUNCTION			
-1000.000	1.2217305	1.00000000	-0.00005	2'	1.00000094	0.00000647	0.00000000	3.88119188
-931.596	1.2217311	1.00000177	-0.00009	2'	1.00000187	0.00001281	0.00000000	3.88119823
-863.192	1.2217323	1.00000529	-0.00018	3'	1.00000370	0.00002540	0.00000000	3.88121081
-794.788	1.2217347	1.00001226	-0.00035	3'	1.00000732	0.00005034	0.00000000	3.88123575
-726.385	1.2217394	1.00002607	-0.00070	3'	1.00001450	0.00009974	0.00000000	3.88128515
-657.983	1.2217487	1.00005342	-0.00139	3'	1.00002873	0.00019760	0.00000000	3.88138302
-589.582	1.2217672	1.00010751	-0.00275	4'	1.00005686	0.00039137	0.00000000	3.88157678
-521.185	1.2218036	1.00021430	-0.00545	4'	1.00011242	0.00077463	0.00000000	3.88196003
-452.795	1.2218753	1.00042431	-0.01080	4'	1.00022171	0.00153123	0.00000000	3.88271664
-384.418	1.2220150	1.00083126	-0.02140	5'	1.00043519	0.00301921	0.00000000	3.88420463
-316.067	1.2222836	1.00162305	-0.04240	6'	1.00084644	0.00592407	0.00000000	3.88710947
-247.767	1.2227852	1.00309919	-0.08394	8'	1.00161778	0.01151530	0.00000000	3.89270071
-179.562	1.2236737	1.00572416	-0.16603	10'	1.00299453	0.02199858	0.00000000	3.90318402
-111.523	1.2251099	1.00999530	-0.32784	16'	1.00524652	0.04077078	0.00000000	3.92195627
-43.754	1.2271216	1.01603755	-0.64562	41'	1.00844923	0.07201268	0.00000000	3.95319817
23.635	1.2294440	1.02310044	-0.78950	77'	1.01219850	0.09043450		
90.588	1.2316017	1.02974793	-0.40419	21'	1.01570775	0.05400711		
157.133	1.2332435	1.03486225	-0.20777	12'	1.01837890	0.03142899		
223.369	1.2343160	1.03822992	-0.10713	9'	1.02011876	0.01843058		
289.403	1.2349497	1.04022950	-0.05535	7'	1.02114346	0.01129016		
355.316	1.2353023	1.04134545	-0.02863	6'	1.02171240	0.00747269		
421.163	1.2354920	1.04194694	-0.01482	5'	1.02201816	0.00546190		
486.975	1.2355923	1.04226513	-0.00768	4'	1.02217964	0.00441113		
552.767	1.2356448	1.04243175	-0.00398	4'	1.02226413	0.00386433		
618.550	1.2356722	1.04251856	-0.00206	3'	1.02230813	0.00358039		
684.327	1.2356864	1.04256365	-0.00107	3'	1.02233099	0.00343312		
750.101	1.2356937	1.04258706	-0.00055	3'	1.02234284	0.00335678		
815.875	1.2356975	1.04259919	-0.00029	3'	1.02234899	0.00331723		
881.647	1.2356995	1.04260546	-0.00015	3'	1.02235217	0.00329673		
947.419	1.2357005	1.04260872	-0.00008	2'	1.02235382	0.00328611		
1013.191	1.2357011	1.04261041	-0.00004	2'	1.02235468	0.00328061		

OMEGA 30000000 KAPPA 0.0100 DELTA 0.010000 VECTORLENGTH 0.60
ALPHA -0.46280 BETA -2.16078 GAMMA -2.62358
REFLECTIONFACTOR 0.0045596 4.4238388 TRANSITFACTOR 1.2430116 0.0959680

HEIGTH	THETA	E KELLER	ZETA		DISTORTION FUNCTION			
-1000.000	1.4398966	1.00000000	-0.00005	2'	1.00000576	0.00[illegible]1511	0.00455959	4.42385389
-960.842	1.4398974	1.00000622	-0.00007	2'	1.00000852	0.00002235	0.00455960	4.42386113
-921.684	1.4398986	1.00001552	-0.00010	2'	1.00001261	0.00003307	0.00455962	4.42387185
-882.527	1.4399004	1.00002920	-0.00015	3'	1.00001864	0.00004891	0.00455965	4.42388768
-843.370	1.4399030	1.00004952	-0.00022	3'	1.00002757	0.00007235	0.00455969	4.42391112
-804.215	1.4399070	1.00007949	-0.00032	3'	1.00004079	0.00010703	0.00455975	4.42394580
-765.060	1.4399127	1.00012388	-0.00048	3'	1.00006034	0.00015831	0.00455984	4.42399709
-725.907	1.4399213	1.00018952	-0.00070	3'	1.00008924	0.00023416	0.00455997	4.42407294
-686.756	1.4399340	1.00028669	-0.00104	3'	1.00013199	0.00034633	0.00456016	4.42418510
-647.609	1.4399527	1.00043005	-0.00154	3'	1.00019517	0.00051218	0.00456045	4.42435096
-608.468	1.4399803	1.00064217	-0.00228	3'	1.00028857	0.00075736	0.00456088	4.42459613
-569.335	1.4400212	1.00095539	-0.00337	4'	1.00042654	0.00111967	0.00456151	4.42495844
-530.214	1.4400814	1.00141786	-0.00498	4'	1.00063023	0.00165479	0.00456244	4.42549357
-491.112	1.4401701	1.00209961	-0.00736	4'	1.00093067	0.00244457	0.00456380	4.42628334
-452.035	1.4403004	1.00310373	-0.01089	4'	1.00137317	0.00360890	0.00456582	4.42744768
-412.997	1.4404915	1.00457867	-0.01608	5'	1.00202356	0.00532266	0.00456879	4.42916143
-374.016	1.4407703	1.00673871	-0.02375	5'	1.00297663	0.00783909	0.00457313	4.43167788
-335.118	1.4411745	1.00988720	-0.03504	6'	1.00436710	0.01152146	0.00457947	4.43536024
-296.341	1.4417552	1.01444480	-0.05164	6'	1.00638282	0.01688317	0.00458866	4.44072196
-257.736	1.4425787	1.02097863	-0.07597	7'	1.00927846	0.02463478	0.00460187	4.44847356
-219.376	1.4437254	1.03021735	-0.11150	8'	1.01338517	0.03573003	0.00462059	4.45956883
-181.357	1.4452827	1.04303478	-0.16307	10'	1.01910737	0.05139436	0.00464668	4.47523315
-143.802	1.4473292	1.06036882	-0.23740	13'	1.02689378	0.07310715	0.00468219	4.49694596
-106.855	1.4499082	1.08304781	-0.34350	17'	1.03716938	0.10250341	0.00472904	4.52634224
-70.677	1.4529984	1.11152834	-0.49323	25'	1.05022649	0.14117423	0.00478857	4.56501308
-35.420	1.4564957	1.14561736	-0.70174	50'	1.06600012	0.19030138	0.00486094	4.61423022
-1.204	1.4602227	1.18431532	-0.98803	316'	1.09323050	0.24097236	0.00498465	4.66481116
31.900	1.4639666	1.22590341	-0.72687	61'	1.10700932	0.36276470		
63.888	1.4675295	1.26827908	-0.52788	30'	1.13046556	0.29906910		
94.814	1.4707663	1.30939188	-0.38746	20'	1.15182173	0.25016486		
124.772	1.4735978	1.34759798	-0.28716	15'	1.17021055	0.21305987		
153.886	1.4760019	1.38182917	-0.21463	13'	1.18546996	0.18504197		
182.282	1.4779975	1.41158843	-0.16157	11'	1.19783121	0.16389485		
210.082	1.4796258	1.43683629	-0.12236	9'	1.20769044	0.14790259		
237.395	1.4809377	1.45784183	-0.09311	8'	1.21547612	0.13577218		
264.316	1.4819846	1.47504975	-0.07114	8'	1.22156521	0.12654065		
290.925	1.4828141	1.48897595	-0.05452	7'	1.22635914	0.11949295		
317.285	1.4834680	1.50013965	-0.04188	6'	1.23007982	0.11409722		
343.451	1.4839814	1.50902196	-0.03224	6'	1.23297462	0.10995620		
369.462	1.4843832	1.51604795	-0.02486	6'	1.23522428	0.10677170		
395.354	1.4846971	1.52158082	-0.01919	5'	1.23697125	0.10431872		
421.152	1.4849417	1.52592216	-0.01482	5'	1.23832715	0.10242668		
446.877	1.4851322	1.52931964	-0.01146	5'	1.23937914	0.10096577		
472.544	1.4852804	1.53197262	-0.00887	4'	1.24019515	0.09983678		
498.168	1.4853955	1.53404089	-0.00686	4'	1.24082800	0.09896372		
523.757	1.4854850	1.53565128	-0.00531	4'	1.24131873	0.09828822		
549.319	1.4855544	1.53690371	-0.00411	4'	1.24169923	0.09776537		
574.861	1.4856083	1.53787734	-0.00319	4'	1.24199423	0.09736053		
600.387	1.4856501	1.53863285	-0.00247	4'	1.24222294	0.09704699		
625.900	1.4856826	1.53922006	-0.00191	3'	1.24240025	0.09680412		
651.403	1.4857077	1.53967570	-0.00148	3'	1.24253770	0.09661596		
676.899	1.4857272	1.54002963	-0.00115	3'	1.24264426	0.09647016		
702.389	1.4857423	1.54030342	-0.00089	3'	1.24272686	0.09635718		
727.874	1.4857541	1.54051614	-0.00069	3'	1.24279088	0.09626963		
753.356	1.4857632	1.54068129	-0.00053	3'	1.24284052	0.09620178		
778.835	1.4857702	1.54080936	-0.00041	3'	1.24287899	0.09614918		
804.312	1.4857757	1.54090845	-0.00032	3'	1.24290882	0.09610843		

829.788	1.4857799	1.54098532	-0.00025	3'	1.24293194	0.09607683
855.262	1.4857832	1.54104501	-0.00019	3'	1.24294985	0.09605235
880.735	1.4857857	1.54109079	-0.00015	3'	1.24296375	0.09603336
906.208	1.4857877	1.54112703	-0.00012	3'	1.24297452	0.09601866
931.680	1.4857893	1.54115489	-0.00009	2'	1.24298286	0.09600725
957.151	1.4857904	1.54117599	-0.00007	2'	1.24298934	0.09599841
982.622	1.4857914	1.54119276	-0.00005	2'	1.24299435	0.09599156
1008.093	1.4857921	1.54120588	-0.00004	2'	1.24299823	0.09598625

OMEGA 3000000 KAPPA 0.0100 DELTA 0.100000 VECTORLENGTH 0.40
REFLECTIONFACTOR 0.0000239 3.6662693 TRANSITFACTOR 1.4554062 0.6897470
ALPHA -1.89369 BETA -5.28070 GAMMA -7.17439

HEIGTH	THETA	E KELLER	ZETA		DISTORTION FUNCTION			
-1000.000	1.2217305	1.00000000	-0.00005	2'	1.00000865	0.00006207	0.00002390	3.66633137
-931.596	1.2217360	1.00001629	-0.00009	2'	1.00001715	0.00012302	0.00002390	3.66639232
-863.193	1.2217471	1.00004860	-0.00018	2'	1.00003398	0.00024380	0.00002390	3.66651309
-794.792	1.2217689	1.00011263	-0.00035	3'	1.00006733	0.00048313	0.00002390	3.66675242
-726.395	1.2218122	1.00023952	-0.00070	3'	1.00013342	0.00095729	0.00002390	3.66722659
-658.007	1.2218979	1.00049078	-0.00139	3'	1.00026429	0.00189643	0.00002391	3.66816572
-589.634	1.2220674	1.00098810	-0.00275	4'	1.00052327	0.00375527	0.00002391	3.67002457
-521.293	1.2224021	1.00197116	-0.00545	4'	1.00103501	0.00742988	0.00002392	3.67369919
-453.016	1.2230600	1.00390942	-0.01078	4'	1.00204324	0.01467586	0.00002395	3.68094517
-384.861	1.2243436	1.00771197	-0.02131	5'	1.00401833	0.02889454	0.00002400	3.69516385
-315.949	1.2268108	1.01509959	-0.04203	6'	1.00784476	0.05653257	0.00002409	3.72280186
-249.500	1.2314211	1.02918829	-0.08250	8'	1.01510325	0.10029712	0.00002426	3.77556639
-182.921	1.2396050	1.05515201	-0.16054	10'	1.02835044	0.20677450	0.00002458	3.87304373
-117.887	1.2529264	1.10024006	-0.30763	15'	1.05097789	0.37703229	0.00002512	4.04330157
-55.378	1.2719592	1.17155771	-0.57477	32'	1.08587319	0.65000453	0.00002595	4.31627385
3.504	1.2949883	1.27088419	-0.96557	315'	1.13222784	2.35629576		
57.969	1.3184428	1.39052815	-0.56007	41'	1.18736376	1.82278247		
107.905	1.3301415	1.51610502	-0.33992	21'	1.24234397	1.45375370		
153.823	1.3557091	1.63393930	-0.21476	15'	1.29218717	1.20576013		
196.510	1.3682330	1.73574659	-0.14014	11'	1.33372601	1.04087576		
236.746	1.3774165	1.81874615	-0.09372	10'	1.36628758	0.93089151		
275.181	1.3840484	1.88374288	-0.06381	8'	1.39083515	0.85679705		
312.314	1.3888024	1.93323963	-0.04402	7'	1.40891875	0.80630508		
348.512	1.3921982	1.97020526	-0.03065	6'	1.42206427	0.77153358		
384.042	1.3946202	1.99743748	-0.02148	6'	1.43154696	0.74737936		
419.096	1.3963464	2.01730724	-0.01513	5'	1.43835661	0.73048657		
453.809	1.3975765	2.03170647	-0.01069	5'	1.44323348	0.71861150		
488.280	1.3984529	2.04209121	-0.00758	5'	1.44672034	0.71023192		
522.578	1.3990774	2.04955506	-0.00538	4'	1.44921071	0.70430245		
556.753	1.3995223	2.05490670	-0.00382	4'	1.45098818	0.70009821		
590.841	1.3998394	2.05873696	-0.00272	4'	1.45225624	0.69711289		
624.866	1.4000654	2.06147515	-0.00193	4'	1.45316061	0.69499087		
658.847	1.4002264	2.06343097	-0.00138	2'	1.45380545	0.69348133		
692.795	1.4003411	2.06482697	-0.00098	2'	1.45426519	0.69240697		
726.722	1.4004229	2.06582303	-0.00070	2'	1.45459293	0.69164199		
760.632	1.4004812	2.06653342	-0.00050	2'	1.45482654	0.69109719		
794.530	1.4005227	2.06704004	-0.00035	2'	1.45499306	0.69070908		
828.421	1.4005523	2.06740109	-0.00025	2'	1.45511175	0.69043258		
862.305	1.4005734	2.06765876	-0.00018	2'	1.45519634	0.69023557		
896.186	1.4005885	2.06784227	-0.00013	2'	1.45525663	0.69009519		
930.063	1.4005992	2.06797317	-0.00009	2'	1.45529960	0.68999515		
963.938	1.4006068	2.06806638	-0.00007	2'	1.45533023	0.68992385		
997.812	1.4006123	2.06813285	-0.00005	2'	1.45535205	0.68987305		
1031.685	1.4006161	2.06818017	-0.00003	2'	1.45536761	0.68983684		

OMEGA 30000000 KAPPA 0.1000 DELTA 0.000010 VECTORLENGTH 0.21
REFLECTIONFACTOR 0.0000001 3.1416056 TRANSITFACTOR 1.0000025 0
ALPHA -0.00000 BETA -2.00000 GAMMA -2.00001

HEIGTH	THETA	E KELLER	ZETA		DISTORTION FUNCTION			
-100.000	0	1.00000000	-0.00005	2'	1.00000000	0	0.00000006	3.14160559
-89.750	0	1.00000000	-0.00013	3'	1.00000000	0	0.00000006	3.14160559
-79.500	0	1.00000000	-0.00035	3'	1.00000000	0	0.00000006	3.14160559
-69.250	0	1.00000000	-0.00098	3'	1.00000000	0	0.00000006	3.14160559
-59.000	0	1.00000000	-0.00274	4'	1.00000000	0.00000001	0.00000006	3.14160559
-48.750	0	1.00000001	-0.00764	4'	1.00000001	0.00000003	0.00000006	3.14160562
-38.500	0	1.00000005	-0.02128	5'	1.00000004	0.00000008	0.00000006	3.14160567
-28.250	0	1.00000014	-0.05931	7'	1.00000012	0.00000023	0.00000006	3.14160582
-18.000	0	1.00000035	-0.16530	11'	1.00000030	0.00000063	0.00000006	3.14160621
-7.750	0	1.00000079	-0.46070	24'	1.00000072	0.00000162	0.00000006	3.14160720
2.500	0	1.00000140	-0.77880	73'	1.00000145	0.00000253		
12.750	0	1.00000195	-0.27943	15'	1.00000203	0.00000103		
23.000	0	1.00000227	-0.10026	8'	1.00000231	0.00000039		
33.250	0	1.00000241	-0.03597	6'	1.00000243	0.00000014		
43.500	0	1.00000246	-0.01291	5'	1.00000247	0.00000005		
53.750	0	1.00000248	-0.00463	4'	1.00000249	0.00000001		
64.000	0	1.00000250	-0.00166	3'	1.00000250	0		
74.250	0	1.00000250	-0.00060	3'	1.00000250	0		
84.500	0	1.00000250	-0.00021	3'	1.00000250	0		
94.750	0	1.00000250	-0.00008	2'	1.00000250	0		
105.000	0	1.00000250	-0.00003	2'	1.00000250	0		

OMEGA 3000000 KAPPA o.1000 DELTA o.00001o VECTORLENGTH o.2o
REFLECTIONFACTOR o.0000001 3.1416o56 TRANSITFACTOR 1.0000026 o
ALPHA -o.00001 BETA -1.96962 GAMMA -1.96963.

HEIGTH	THETA	E KELLER .	ZETA		DISTORTION FUNCTION			
-1oo.000	o.1745329	1.0000000	-o.00005	2'	1.0000000	o	o.0000007	3.1416o559
-9o.152	o.1745329	1.0000000	-o.00012	2'	1.0000000	o	o.0000007	3.1416o559
-8o.3o4	o.1745329	1.0000000	-o.00033	3'	1.0000000	o	o.0000007	3.1416o559
-7o.456	o.1745329	1.0000000	-o.00087	3'	1.0000000	o	o.0000007	3.1416o559
-6o.6o8	o.1745329	1.0000000	-o.00233	3'	1.0000000	o.0000001	o.0000007	3.1416o559
-5o.76o	o.1745329	1.0000001	-o.00625	4'	1.0000001	o.0000002	o.0000007	3.1415o561
-4o.912	o.1745329	1.0000004	-o.01672	5'	1.0000003	o.0000007	o.0000007	3.1416o565
-31.o63	o.174533o	1.0000011	-o.04476	6'	1.0000009	o.0000018	o.0000007	3.1416o576
-21.215	o.174533o	1.0000028	-o.11985	9'	1.0000023	o.0000047	o.0000007	3.1416o6o5
-11.367	o.1745331	1.0000064	-o.32087	16'	1.0000055	o.0000118	o.0000007	3.1416o676
-1.519	o.1745333	1.0000122	-o.859o5	119'	1.0000112	o.0000278	o.0000007	3.1416o836
8.329	o.1745335	1.0000185	-o.13479	22'	1.0000191	o.0000156		
18.177	o.1745337	1.0000228	-o.1624o	1o'	1.000023o	o.0000063		
28.o25	o.1745338	1.000025o	-o.06066	7'	1.0000248	o.0000024		
37.873	o.1745338	1.000026o	-o.02265	5'	1.0000256	o.0000009		
47.721	o.1745338	1.0000263	-o.00846	4'	1.0000259	o.0000004		
57.569	o.1745338	1.0000264	-o.00316	4'	1.000026o	o.0000001		
67.417	o.1745338	1.0000265	-o.00118	3'	1.000026o	o		
77.265	o.1745338	1.0000266	-o.00044	3'	1.000026o	o		
87.113	o.1745338	1.0000266	-o.00016	3'	1.000026o	o		
96.962	o.1745338	1.0000266	-o.00006	2'	1.000026o	o		
1o6.81o	o.1745338	1.0000266	-o.00002	2'	1.000026o	o		

OMEGA 3oooooo KAPPA o.1ooo DELTA o.oooo1o VECTORLENGTH o.4o
REFLECTIONFACTOR o.oooo1o9 3.1416o15 TRANSITFACTOR 1.oooo214 o
ALPHA -o.oooo1 BETA -o.684o3 GAMMA -o.684o4

HEIGTH	THETA	E KELLER	ZETA		DISTORTION FUNCTION			
-1oo.ooo	1.22173o5	1.oooooooo	-o.oooo5	2'	1.oooooooo	o	o.oooo1o86	3.1416o451
-93.16o	1.22173o5	1.oooooooo	-o.oooo9	2'	1.oooooooo	o	o.oooo1o86	3.1416o451
-86.319	1.22173o5	1.oooooooo	-o.ooo18	3'	1.oooooooo	o	o.oooo1o86	3.1416o451
-79.479	1.22173o5	1.ooooooo1	-o.ooo35	3'	1.oooooooo	o	o.oooo1o86	3.1416o451
-72.638	1.22173o5	1.ooooooo3	-o.ooo7o	3'	1.oooooooo	o	o.oooo1o86	3.1416o451
-65.798	1.22173o5	1.ooooooo4	-o.oo139	3'	1.ooooooo1	o	o.oooo1o86	3.1416o451
-58.958	1.22173o5	1.oooooo1o	-o.oo275	4'	1.ooooooo2	o.ooooooo1	o.oooo1o86	3.1416o451
-52.117	1.22173o5	1.oooooo2o	-o.oo545	4'	1.ooooooo4	o.ooooooo2	o.oooo1o86	3.1416o453
-45.277	1.22173o6	1.oooooo42	-o.o1o81	4'	1.ooooooo7	o.ooooooo5	o.oooo1o86	3.1416o455
-38.436	1.22173o8	1.oooooo84	-o.o2142	5'	1.oooooo15	o.oooooo1o	o.oooo1o85	3.1416o46o
-31.596	1.221731o	1.ooooo163	-o.o4244	6'	1.oooooo29	o.oooooo19	o.oooo1o86	3.1416o47o
-24.756	1.2217315	1.ooooo312	-o.o8412	8'	1.oooooo56	o.oooooo39	o.oooo1o86	3.1416o489
-17.915	1.2217324	1.ooooo573	-o.16671	11'	1.ooooo1o8	o.oooooo76	o.oooo1o86	3.1416o526
-11.o75	1.2217339	1.ooooo998	-o.33o39	17'	1.ooooo2o3	o.ooooo146	o.oooo1o86	3.1416o597
-4.234	1.2217359	1.oooo1592	-o.65478	43'	1.ooooo371	o.ooooo278	o.oooo1o86	3.1416o728
2.6o6	1.2217382	1.oooo2272	-o.77o6o	7o'	1.oooo1715	o.ooooo322		
9.446	1.22174o3	1.oooo2895	-o.38883	2o'	1.oooo19o4	o.ooooo171		
16.286	1.2217419	1.oooo3364	-o.1962o	12'	1.oooo2o14	o.oooooo89		
23.126	1.221743o	1.oooo366o	-o.099oo	8'	1.oooo2o75	o.oooooo45		
29.967	1.2217435	1.oooo3831	-o.o4995	7'	1.oooo21o7	o.oooooo23		
36.8o7	1.2217439	1.oooo3924	-o.o2521	5'	1.oooo2123	o.oooooo12		
43.647	1.221744o	1.oooo3972	-o.o1272	5'	1.oooo2131	o.ooooooo6		
5o.487	1.2217441	1.oooo3997	-o.oo642	4'	1.oooo2135	o.ooooooo3		
57.327	1.2217442	1.oooo4o1o	-o.oo324	4'	1.oooo2138	o.ooooooo1		
64.167	1.2217442	1.oooo4o17	-o.oo163	3'	1.oooo2139	o.ooooooo1		
71.oo8	1.2217442	1.oooo4o2o	-o.ooo82	3'	1.oooo2139	o		
77.848	1.2217442	1.oooo4o23	-o.ooo42	3'	1.oooo214o	o		
84.688	1.2217442	1.oooo4o24	-o.ooo21	3'	1.oooo214o	o		
91.528	1.2217142	1.oooo4o24	-o.ooo11	2'	1.oooo214o	o		
98.368	1.2217442	1.oooo4o24	-o.oooo5	2'	1.oooo214o	o		
1o5.2o8	1.2217442	1.oooo4o24	-o.oooo3	2'	1.oooo214o	o		

OMEGA 3000000 KAPPA 0.1000 DELTA 0.000010 VECTORLENGTH 0.40
ALPHA -0.00006 BETA -0.17426 GAMMA -0.17431
REFLECTIONFACTOR 0.0003134 3.1415967 TRANSITFACTOR 1.0003293 0

HEIGTH	THETA	F. KELLER	ZETA		DISTORTION FUNCTION			
-100.000	1.4835298	1.00000000	-0.00005	2'	1.00000000	0	0.00031344	3.14159673
-96.514	1.4835298	1.00000000	-0.00006	2'	1.00000000	0	0.00031344	3.14159673
-93.028	1.4835298	1.00000000	-0.00009	2'	1.00000000	0	0.00031344	3.14159673
-89.541	1.4835298	1.00000000	-0.00013	3'	1.00000000	0	0.00031344	3.14159673
-86.055	1.4835298	1.00000000	-0.00018	3'	1.00000000	0	0.00031344	3.14159673
-82.569	1.4835298	1.00000000	-0.00026	3'	1.00000000	0	0.00031344	3.14159673
-79.083	1.4835298	1.00000021	-0.00037	3'	1.00000000	0	0.00031344	3.14159673
-75.596	1.4835298	1.00000021	-0.00052	3'	1.00000000	0	0.00031344	3.14159673
-72.110	1.4835298	1.00000047	-0.00074	3'	1.00000001	0	0.00031344	3.14159673
-68.624	1.4835298	1.00000047	-0.00105	3'	1.00000001	0	0.00031344	3.14159673
-65.138	1.4835299	1.00000098	-0.00148	3'	1.00000001	0	0.00031344	3.14159673
-61.651	1.4835299	1.00000145	-0.00210	3'	1.00000002	0	0.00031344	3.14159673
-58.165	1.4835300	1.00000218	-0.00298	4'	1.00000003	0	0.00031344	3.14159673
-54.679	1.4835301	1.00000290	-0.00422	4'	1.00000004	0	0.00031344	3.14159674
-51.193	1.4835302	1.00000414	-0.00598	4'	1.00000006	0.00000001	0.00031344	3.14159674
-47.707	1.4835303	1.00000563	-0.00847	4'	1.00000008	0.00000001	0.00031344	3.14159675
-44.220	1.4835305	1.00000808	-0.01201	5'	1.00000012	0.00000002	0.00031344	3.14159675
-40.734	1.4835308	1.00001128	-0.01702	5'	1.00000016	0.00000003	0.00031344	3.14159676
-37.248	1.4835311	1.00001543	-0.02412	5'	1.00000023	0.00000004	0.00031344	3.14159677
-33.762	1.4835317	1.00002154	-0.03418	6'	1.00000033	0.00000006	0.00031344	3.14159679
-30.276	1.4835325	1.00003038	-0.04843	6'	1.00000047	0.00000008	0.00031344	3.14159682
-26.789	1.4835335	1.00004214	-0.06864	7'	1.00000066	0.00000011	0.00031344	3.14159685
-23.303	1.4835349	1.00005834	-0.09726	8'	1.00000092	0.00000016	0.00031344	3.14159690
-19.817	1.4835367	1.00007942	-0.13783	10'	1.00000130	0.00000023	0.00031344	3.14159696
-16.331	1.4835391	1.00010716	-0.19531	12'	1.00000181	0.00000032	0.00031344	3.14159705
-12.846	1.4835422	1.00014222	-0.27677	15'	1.00000251	0.00000045	0.00031344	3.14159719
-9.360	1.4835459	1.00018493	-0.39220	20'	1.00000349	0.00000063	0.00031344	3.14159737
-5.874	1.4835502	1.00023450	-0.55576	31'	1.00000477	0.00000088	0.00031344	3.14159761
-2.389	1.4835550	1.00028398	-0.78751	76'	1.00000648	0.00000122	0.00031344	3.14159796
1.096	1.4835599	1.00034591	-0.89616	165'	1.00032206	0.00000138		
4.581	1.4835648	1.00040185	-0.63246	40'	1.00032396	0.00000100		
8.066	1.4835693	1.00045392	-0.44636	23'	1.00032540	0.00000072		
11.551	1.4835733	1.00049910	-0.31503	16'	1.00032648	0.00000051		
15.035	1.4835766	1.00053693	-0.22234	12'	1.00032727	0.00000037		
18.520	1.4835792	1.00056739	-0.15693	10'	1.00032784	0.00000026		
22.004	1.4835813	1.00059097	-0.11076	9'	1.00032827	0.00000019		
25.488	1.4835828	1.00060864	-0.07817	8'	1.00032856	0.00000013		
28.972	1.4835840	1.00062217	-0.05518	7'	1.00032879	0.00000009		
32.456	1.4835848	1.00063175	-0.03894	6'	1.00032894	0.00000007		
35.940	1.4835854	1.00063886	-0.02749	6'	1.00032905	0.00000004		
39.425	1.4835859	1.00064378	-0.01940	5'	1.00032913	0.00000003		
42.908	1.4835862	1.00064771	-0.01369	5'	1.00032919	0.00000002		
46.392	1.4835864	1.00065015	-0.00966	4'	1.00032922	0.00000001		
49.876	1.4835866	1.00065212	-0.00682	4'	1.00032925	0.00000001		
53.360	1.4835867	1.00065336	-0.00481	4'	1.00032926	0.00000001		
56.844	1.4835868	1.00065435	-0.00340	4'	1.00032928	0		
60.328	1.4835869	1.00065508	-0.00240	3'	1.00032929	0		
63.812	1.4835869	1.00065533	-0.00169	3'	1.00032929	0		
67.296	1.4835869	1.00065584	-0.00119	3'	1.00032930	0		
70.780	1.4835869	1.00065606	-0.00084	3'	1.00032930	0		
74.264	1.4835869	1.00065606	-0.00060	3'	1.00032930	0		
77.748	1.4835870	1.00065632	-0.00042	3'	1.00032931	0		
81.232	1.4835870	1.00065657	-0.00030	3'	1.00032931	0		
84.716	1.4835870	1.00065657	-0.00021	3'	1.00032931	0		
88.200	1.4835870	1.00065657	-0.00015	3'	1.00032931	0		
91.684	1.4835870	1.00065657	-0.00010	2'	1.00032931	0		
95.168	1.4835870	1.00065657	-0.00007	2'	1.00032931	0		

98.652	1.4835870	1.00065657	-0.00005	2'	1.00032931	0
102.136	1.4835870	1.00065657	-0.00004	2'	1.00032931	0

OMEGA 30000000 KAPPA 0.1000 DELTA 0.000010 VECTORLENGTH 0.50
ALPHA -0.00011 BETA -0.08712 GAMMA -0.08724
REFLECTIONFACTOR 0.0013011 3.1415947 TRANSITFACTOR 1.0013174 0

HEIGTH	THETA	E KELLER	ZETA		DISTORTION FUNCTION			
-100.000	1.5271629	1.00000000	-0.00005	2'	1.00000000	0	0.00130109	3.14159473
-97.819	1.5271629	1.00000000	-0.00006	2'	1.00000000	0	0.00130109	3.14159473
-95.638	1.5271629	1.00000000	-0.00007	2'	1.00000000	0	0.00130109	3.14159473
-93.457	1.5271629	1.00000000	-0.00009	2'	1.00000000	0	0.00130109	3.14159473
-91.276	1.5271629	1.00000000	-0.00011	2'	1.00000000	0	0.00130109	3.14159473
-89.095	1.5271629	1.00000000	-0.00014	3'	1.00000000	0	0.00130109	3.14159473
-86.914	1.5271629	1.00000000	-0.00017	3'	1.00000000	0	0.00130109	3.14159473
-84.733	1.5271629	1.00000000	-0.00021	3'	1.00000000	0	0.00130109	3.14159473
-82.552	1.5271629	1.00000000	-0.00026	3'	1.00000000	0	0.00130109	3.14159473
-80.371	1.5271630	1.00000094	-0.00032	3'	1.00000000	0	0.00130109	3.14159473
-78.190	1.5271630	1.00000094	-0.00040	3'	1.00000000	0	0.00130109	3.14159473
-76.009	1.5271630	1.00000094	-0.00050	3'	1.00000001	0	0.00130109	3.14159473
-73.828	1.5271630	1.00000094	-0.00062	3'	1.00000001	0	0.00130109	3.14159473
-71.647	1.5271630	1.00000188	-0.00077	3'	1.00000001	0	0.00130109	3.14159473
-69.466	1.5271630	1.00000188	-0.00096	3'	1.00000001	0	0.00130109	3.14159473
-67.285	1.5271631	1.00000290	-0.00120	3'	1.00000001	0	0.00130109	3.14159473
-65.104	1.5271631	1.00000384	-0.00149	3'	1.00000001	0	0.00130109	3.14159473
-62.923	1.5271631	1.00000487	-0.00185	3'	1.00000002	0	0.00130109	3.14159473
-60.742	1.5271632	1.00000580	-0.00230	3'	1.00000002	0	0.00130109	3.14159473
-58.561	1.5271632	1.00000683	-0.00286	4'	1.00000003	0	0.00130109	3.14159473
-56.381	1.5271634	1.00000973	-0.00356	4'	1.00000003	0	0.00130109	3.14159473
-54.200	1.5271634	1.00001170	-0.00443	4'	1.00000004	0	0.00130109	3.14159473
-52.019	1.5271636	1.00001460	-0.00551	4'	1.00000005	0	0.00130109	3.14159473
-49.838	1.5271637	1.00001853	-0.00685	4'	1.00000007	0	0.00130109	3.14159474
-47.657	1.5271639	1.00002245	-0.00852	4'	1.00000009	0	0.00130109	3.14159474
-45.476	1.5271642	1.00002835	-0.01059	4'	1.00000010	0.00000001	0.00130109	3.14159474
-43.295	1.5271645	1.00003519	-0.01317	5'	1.00000013	0.00000001	0.00130109	3.14159474
-41.114	1.5271648	1.00004304	-0.01638	5'	1.00000016	0.00000001	0.00130109	3.14159475
-38.933	1.5271652	1.00005287	-0.02038	5'	1.00000020	0.00000001	0.00130109	3.14159475
-36.752	1.5271658	1.00006457	-0.02534	5'	1.00000025	0.00000002	0.00130109	3.14159475
-34.571	1.5271664	1.00008019	-0.03152	6'	1.00000031	0.00000003	0.00130109	3.14159475
-32.391	1.5271672	1.00009882	-0.03920	6'	1.00000038	0.00000004	0.00130109	3.14159476
-30.210	1.5271682	1.00012137	-0.04875	6'	1.00000048	0.00000004	0.00130109	3.14159477
-28.029	1.5271695	1.00014973	-0.06063	7'	1.00000059	0.00000005	0.00130109	3.14159478
-25.848	1.5271710	1.00018407	-0.07541	7'	1.00000073	0.00000007	0.00130109	3.14159479
-23.668	1.5271728	1.00022517	-0.09378	8'	1.00000091	0.00000008	0.00130109	3.14159480
-21.487	1.5271749	1.00027422	-0.11663	9'	1.00000112	0.00000010	0.00130109	3.14159483
-19.307	1.5271775	1.00033301	-0.14505	10'	1.00000139	0.00000013	0.00130109	3.14159485
-17.127	1.5271804	1.00040156	-0.18038	11'	1.00000172	0.00000015	0.00130109	3.14159488
-14.947	1.5271839	1.00048097	-0.22132	13'	1.00000211	0.00000019	0.00130109	3.14159492
-12.767	1.5271879	1.00057313	-0.27896	15'	1.00000260	0.00000023	0.00130109	3.14159496
-10.587	1.5271925	1.00067711	-0.34691	18'	1.00000319	0.00000029	0.00130110	3.14159501
-8.408	1.5271975	1.00079291	-0.43139	22'	1.00000389	0.00000036	0.00130110	3.14159508
-6.228	1.5272029	1.00091756	-0.53613	29'	1.00000473	0.00000044	0.00130110	3.14159516
-4.049	1.5272088	1.00105302	-0.66702	45'	1.00000575	0.00000054	0.00130110	3.14159527
-1.871	1.5272149	1.00119255	-0.82939	97'	1.00000694	0.00000066	0.00130110	3.14159539
0.308	1.5272211	1.00133502	-0.96969	316'	1.00136741	0.00000076		
2.486	1.5272273	1.00147856	-0.77990	73'	1.00131031	0.00000062		
4.664	1.5272334	1.00161717	-0.62728	39'	1.00131197	0.00000051		
6.841	1.5272391	1.00174999	-0.50454	27'	1.00131293	0.00000041		
9.018	1.5272444	1.00187205	-0.40583	20'	1.00131375	0.00000031		
11.195	1.5272493	1.00198436	-0.32644	17'	1.00131442	0.00000027		
13.372	1.5272538	1.00208674	-0.26258	14'	1.00131499	0.00000022		
15.549	1.5272576	1.00217449	-0.21123	12'	1.00131544	0.00000018		
17.725	1.5272609	1.00225135	-0.16992	11'	1.00131582	0.00000014		
19.901	1.5272638	1.00231733	-0.13669	10'	1.00131612	0.00000012		
22.077	1.5272662	1.00237353	-0.10996	9'	1.00131637	0.00000010		

24.252	1.5272683	1.00242090	-0.08846	8'	1.00131658	0.00000007
26.428	1.5272700	1.00246029	-0.07116	7'	1.00131673	0.00000006
28.604	1.5272714	1.00249290	-0.05725	7'	1.00131687	0.00000005
30.779	1.5272726	1.00251951	-0.04605	6'	1.00131699	0.00000004
32.955	1.5272735	1.00254123	-0.03705	6'	1.00131707	0.00000003
35.130	1.5272743	1.00255900	-0.02981	6'	1.00131714	0.00000002
37.306	1.5272749	1.00257377	-0.02398	5'	1.00131720	0.00000002
39.481	1.5272754	1.00258561	-0.01929	5'	1.00131724	0.00000001
41.656	1.5272759	1.00259548	-0.01552	5'	1.00131728	0.00000001
43.832	1.5272762	1.00260338	-0.01249	5'	1.00131731	0.00000001
46.007	1.5272765	1.00260931	-0.01004	4'	1.00131734	0.00000001
48.182	1.5272767	1.00261420	-0.00808	4'	1.00131736	0
50.358	1.5272769	1.00261918	-0.00650	4'	1.00131737	0
52.533	1.5272770	1.00262210	-0.00523	4'	1.00131738	0
54.708	1.5272771	1.00262510	-0.00421	4'	1.00131739	0
56.883	1.5272772	1.00262707	-0.00339	4'	1.00131740	0
59.059	1.5272773	1.00262905	-0.00272	4'	1.00131740	0
61.234	1.5272774	1.00263000	-0.00219	3'	1.00131741	0
63.409	1.5272774	1.00263103	-0.00176	3'	1.00131742	0
65.585	1.5272774	1.00263197	-0.00142	3'	1.00131742	0
67.760	1.5272775	1.00263300	-0.00114	3'	1.00131713	0
69.935	1.5272775	1.00263394	-0.00092	3'	1.00131742	0
72.110	1.5272775	1.00263394	-0.00074	3'	1.00131743	0
74.286	1.5272775	1.00263394	-0.00059	3'	1.00131743	0
76.461	1.5272776	1.00263497	-0.00048	3'	1.00131743	0
78.636	1.5272776	1.00263497	-0.00038	3'	1.00131743	0
80.811	1.5272776	1.00263592	-0.00031	3'	1.00131743	0
82.987	1.5272776	1.00263592	-0.00025	3'	1.00131743	0
85.162	1.5272776	1.00263592	-0.00020	3'	1.00131743	0
87.337	1.5272776	1.00263592	-0.00016	3'	1.00131743	0
89.512	1.5272776	1.00263592	-0.00013	3'	1.00131743	0
91.688	1.5272776	1.00263592	-0.00010	2'	1.00131743	0
93.863	1.5272776	1.00263592	-0.00008	2'	1.00131743	0
96.038	1.5272776	1.00263592	-0.00007	2'	1.00131743	0
98.213	1.5272776	1.00263592	-0.00005	2'	1.00131743	0
100.389	1.5272776	1.00263592	-0.00004	2'	1.00131743	0

OMEGA 3000000 KAPPA 0.1000 DELTA 0.000100 VECTORLENGTH 0.40
REFLECTIONFACTOR 0.0001086 3.1417113 TRANSITFACTOR 1.0002138 0.000000
ALPHA -0.00015 BETA -0.68393 GAMMA -0.68407

HEIGTH	THETA	E KELLER	ZETA		DISTORTION FUNCTION			
-100.000	1.2217305	1.00000000	-0.00005	2'	1.00000000	0	0.00010864	3.14171135
-93.160	1.2217305	1.00000002	-0.00009	2'	1.00000001	0	0.00010864	3.14171135
-86.319	1.2217305	1.00000005	-0.00018	3'	1.00000001	0.00000001	0.00010864	3.14171135
-79.479	1.2217305	1.00000011	-0.00035	3'	1.00000002	0.00000001	0.00010864	3.14171136
-72.638	1.2217306	1.00000025	-0.00070	3'	1.00000005	0.00000003	0.00010864	3.14171138
-65.798	1.2217307	1.00000054	-0.00139	3'	1.00000009	0.00000007	0.00010864	3.14171141
-58.958	1.2217308	1.00000107	-0.00275	4'	1.00000019	0.00000013	0.00010864	3.14171147
-52.117	1.2217312	1.00000215	-0.00545	4'	1.00000037	0.00000025	0.00010864	3.14171160
-45.277	1.2217319	1.00000428	-0.01081	4'	1.00000073	0.00000050	0.00010864	3.14171185
-38.436	1.2217333	1.00000840	-0.02142	5'	1.00000145	0.00000099	0.00010864	3.14171234
-31.596	1.2217361	1.00001636	-0.04244	6'	1.00000285	0.00000197	0.00010864	3.14171331
-24.756	1.2217411	1.00003119	-0.08411	8'	1.00000558	0.00000387	0.00010864	3.14171521
-17.916	1.2217501	1.00005747	-0.16670	11'	1.00001078	0.00000757	0.00010864	3.14171891
-11.076	1.2217646	1.00009990	-0.33037	17'	1.00002038	0.00001463	0.00010864	3.14172598
-4.236	1.2217848	1.00015922	-0.65470	43'	1.00003717	0.00002776	0.00010864	3.14173911
2.604	1.2218080	1.00022730	-0.77077	70'	1.00017119	0.00003222		
9.443	1.2218294	1.00028981	-0.38897	20'	1.00019017	0.00001710		
16.281	1.2218453	1.00033652	-0.19630	12'	1.00020121	0.00000888		
23.119	1.2218555	1.00036631	-0.09907	8'	1.00020726	0.00000455		
29.957	1.2218613	1.00038344	-0.05000	7'	1.00021045	0.00000232		
36.795	1.2218645	1.00039270	-0.02523	5'	1.00021209	0.00000118		
43.633	1.2218661	1.00039756	-0.01274	5'	1.00021293	0.00000060		
50.471	1.2218670	1.00040006	-0.00643	4'	1.00021336	0.00000031		
57.309	1.2218674	1.00040133	-0.00324	4'	1.00021358	0.00000016		
64.147	1.2218676	1.00040196	-0.00164	3'	1.00021368	0.00000009		
70.985	1.2218677	1.00040231	-0.00083	3'	1.00021374	0.00000004		
77.822	1.2218678	1.00040247	-0.00042	3'	1.00021376	0.00000003		
84.660	1.2218678	1.00040254	-0.00021	3'	1.00021378	0.00000002		
91.498	1.2218678	1.00040257	-0.00011	2'	1.00021379	0.00000001		
98.336	1.2218678	1.00040261	-0.00005	2'	1.00021379	0.00000001		
105.174	1.2218679	1.00040264	-0.00003	2'	1.00021379	0.00000001		

OMEGA 3000000 KAPPA 0.1000 DELTA 0.000100 VECTORLENGTH 0.40
ALPHA -0.00058 BETA -0.17374 GAMMA -0.17432
REFLECTIONFACTOR 0.0031537 3.1416335 TRANSITFACTOR 1.0033132 0.0000001

HEIGTH	THETA	E KELLER	ZETA		DISTORTION FUNCTION			
-100.000	1.4835298	1.00000000	-0.00005	2'	1.00000000	0	0.00315371	3.14163350
-96.514	1.4835298	1.00000000	-0.00006	2'	1.00000000	0	0.00315371	3.14163350
-93.028	1.4835298	1.00000021	-0.00009	2'	1.00000001	0	0.00315371	3.14163350
-89.541	1.4835298	1.00000047	-0.00013	3'	1.00000001	0	0.00315371	3.14163350
-86.055	1.4835299	1.00000072	-0.00018	3'	1.00000002	0	0.00315371	3.14163350
-82.569	1.4835299	1.00000145	-0.00026	3'	1.00000003	0	0.00315371	3.14163350
-79.083	1.4835300	1.00000218	-0.00037	3'	1.00000004	0	0.00315371	3.14163351
-75.596	1.4835301	1.00000316	-0.00052	3'	1.00000005	0.00000001	0.00315371	3.14163351
-72.110	1.4835302	1.00000465	-0.00074	3'	1.00000007	0.00000001	0.00315371	3.14163351
-68.624	1.4835304	1.00000684	-0.00105	3'	1.00000010	0.00000001	0.00315371	3.14163352
-65.138	1.4835306	1.00000953	-0.00148	3'	1.00000014	0.00000002	0.00315371	3.14163353
-61.652	1.4835310	1.00001346	-0.00210	3'	1.00000020	0.00000004	0.00315371	3.14163354
-58.165	1.4835315	1.00001910	-0.00298	4'	1.00000029	0.00000005	0.00315371	3.14163355
-54.679	1.4835322	1.00002719	-0.00422	4'	1.00000041	0.00000007	0.00315371	3.14163357
-51.193	1.4835332	1.00003872	-0.00598	4'	1.00000057	0.00000010	0.00315371	3.14163360
-47.707	1.4835346	1.00005492	-0.00847	4'	1.00000082	0.00000014	0.00315371	3.14163364
-44.221	1.4835366	1.00007749	-0.01201	5'	1.00000116	0.00000020	0.00315371	3.14163370
-40.735	1.4835394	1.00010960	-0.01702	5'	1.00000164	0.00000029	0.00315371	3.14163379
-37.249	1.4835432	1.00015424	-0.02412	5'	1.00000233	0.00000041	0.00315372	3.14163391
-33.763	1.4835487	1.00021632	-0.03417	6'	1.00000329	0.00000057	0.00315372	3.14163408
-30.278	1.4835562	1.00030270	-0.04842	6'	1.00000464	0.00000081	0.00315372	3.14163432
-26.793	1.4835665	1.00042102	-0.06861	7'	1.00000655	0.00000115	0.00315373	3.14163465
-23.308	1.4835804	1.00058138	-0.09722	8'	1.00000921	0.00000162	0.00315374	3.14163513
-19.824	1.4835990	1.00079441	-0.13774	10'	1.00001293	0.00000229	0.00315375	3.14163579
-16.340	1.4836231	1.00107203	-0.19514	12'	1.00001807	0.00000323	0.00315377	3.14163672
-12.858	1.4836536	1.00142280	-0.27644	15'	1.00002514	0.00000452	0.00315379	3.14163803
-9.376	1.4836907	1.00184982	-0.39155	20'	1.00003474	0.00000633	0.00315382	3.14163983
-5.897	1.4837339	1.00234704	-0.55451	31'	1.00004764	0.00000881	0.00315386	3.14164231
-2.419	1.4837815	1.00289616	-0.78517	75'	1.00006466	0.00001219	0.00315391	3.14164568
1.058	1.4838311	1.00346925	-0.89964	171'	1.00324022	0.00001386		
4.532	1.4838799	1.00403291	-0.63560	40'	1.00325920	0.00001008		
8.004	1.4839250	1.00455524	-0.44914	23'	1.00327364	0.00000729		
11.475	1.4839646	1.00501417	-0.31744	16'	1.00328447	0.00000527		
14.944	1.4839978	1.00539820	-0.22439	13'	1.00329246	0.00000380		
18.411	1.4840244	1.00570760	-0.15864	10'	1.00329831	0.00000275		
21.878	1.4840452	1.00594811	-0.11217	9'	1.00330255	0.00000199		
25.343	1.4840609	1.00613062	-0.07931	8'	1.00330560	0.00000145		
28.808	1.4840726	1.00626676	-0.05609	7'	1.00330779	0.00000107		
32.273	1.4840812	1.00636696	-0.03966	6'	1.00330935	0.00000080		
35.737	1.4840875	1.00643969	-0.02805	6'	1.00331046	0.00000060		
39.201	1.4840920	1.00649195	-0.01984	5'	1.00331125	0.00000046		
42.665	1.4840952	1.00652945	-0.01403	5'	1.00331181	0.00000037		
46.129	1.4840975	1.00655621	-0.00992	4'	1.00331221	0.00000030		
49.592	1.4840991	1.00657544	-0.00702	4'	1.00331249	0.00000025		
53.056	1.4841003	1.00658869	-0.00496	4'	1.00331270	0.00000022		
56.519	1.4841011	1.00659848	-0.00351	4'	1.00331283	0.00000019		
59.983	1.4841017	1.00660545	-0.00248	4'	1.00331293	0.00000017		
63.446	1.4841021	1.00661021	-0.00176	3'	1.00331300	0.00000016		
66.910	1.4841024	1.00661372	-0.00124	3'	1.00331305	0.00000015		
70.373	1.4841026	1.00661597	-0.00088	3'	1.00331309	0.00000014		
73.837	1.4841028	1.00661771	-0.00062	3'	1.00331312	0.00000014		
77.300	1.4841029	1.00661896	-0.00044	3'	1.00331313	0.00000013		
80.763	1.4841030	1.00661996	-0.00031	3'	1.00331315	0.00000013		
84.227	1.4841030	1.00662048	-0.00022	3'	1.00331316	0.00000013		
87.690	1.4841031	1.00662095	-0.00016	3'	1.00331316	0.00000013		
91.154	1.4841031	1.00662121	-0.00011	2'	1.00331317	0.00000013		
94.617	1.4841031	1.00662147	-0.00008	2'	1.00331317	0.00000013		

98.080	1.4841031	1.00662173	-0.00006	2'	1.00331317	0.00000013
101.544	1.4841031	1.00662173	-0.00004	2'	1.00331317	0.00000013

OMEGA 3000000 KAPPA 0.1000 DELTA 0.000100 VECTORLENGTH 0.50
ALPHA -0.00116 BETA -0.08608 GAMMA -0.08724
REFLECTIONFACTOR 0.0133321 3.1416135 TRANSITFACTOR 1.0134974 0.0000003

HEIGTH	THETA	E KELLER	ZETA		DISTORTION FUNCTION			
-100.000	1.5271629	1.00000000	-0.00005	2'	1.00000000	0	0.01333206	3.14161348
-97.819	1.5271629	1.00000000	-0.00006	2'	1.00000000	0	0.01333206	3.14161348
-95.638	1.5271629	1.00000000	-0.00007	2'	1.00000001	0	0.01333206	3.14161348
-93.457	1.5271630	1.00000094	-0.00009	2'	1.00000001	0	0.01333206	3.14161348
-91.276	1.5271630	1.00000094	-0.00011	2'	1.00000001	0	0.01333206	3.14161348
-89.095	1.5271630	1.00000187	-0.00014	3'	1.00000001	0	0.01333206	3.14161348
-86.914	1.5271631	1.00000290	-0.00017	3'	1.00000001	0	0.01333206	3.14161348
-84.733	1.5271631	1.00000384	-0.00021	3'	1.00000002	0	0.01333206	3.14161348
-82.552	1.5271631	1.00000487	-0.00026	3'	1.00000003	0	0.01333206	3.14161348
-80.371	1.5271632	1.00000683	-0.00032	3'	1.00000003	0	0.01333206	3.14161348
-78.190	1.5271634	1.00000973	-0.00040	3'	1.00000004	0	0.01333206	3.14161348
-76.009	1.5271635	1.00001272	-0.00050	3'	1.00000005	0	0.01333206	3.14161348
-73.828	1.5271636	1.00001563	-0.00062	3'	1.00000006	0	0.01333206	3.14161348
-71.647	1.5271638	1.00001955	-0.00077	3'	1.00000008	0	0.01333206	3.14161349
-69.466	1.5271640	1.00002442	-0.00096	3'	1.00000009	0.00000001	0.01333206	3.14161349
-67.286	1.5271643	1.00003126	-0.00120	3'	1.00000012	0.00000001	0.01333206	3.14161349
-65.105	1.5271646	1.00003715	-0.00149	3'	1.00000015	0.00000001	0.01333206	3.14161349
-62.924	1.5271650	1.00004697	-0.00185	3'	1.00000019	0.00000001	0.01333206	3.14161350
-60.743	1.5271655	1.00005867	-0.00230	3'	1.00000023	0.00000002	0.01333206	3.14161350
-58.562	1.5271661	1.00007336	-0.00286	4'	1.00000028	0.00000002	0.01333206	3.14161351
-56.381	1.5271669	1.00009198	-0.00356	4'	1.00000035	0.00000003	0.01333206	3.14161351
-54.200	1.5271679	1.00011454	-0.00443	4'	1.00000043	0.00000004	0.01333206	3.14161352
-52.020	1.5271691	1.00014196	-0.00551	4'	1.00000054	0.00000004	0.01333206	3.14161353
-49.839	1.5271707	1.00017716	-0.00685	4'	1.00000068	0.00000006	0.01333207	3.14161354
-47.658	1.5271725	1.00022030	-0.00852	4'	1.00000085	0.00000007	0.01333207	3.14161356
-45.478	1.5271749	1.00027422	-0.01059	4'	1.00000105	0.00000009	0.01333207	3.14161357
-43.298	1.5271778	1.00033985	-0.01317	5'	1.00000130	0.00000011	0.01333207	3.14161360
-41.117	1.5271813	1.00042215	-0.01638	5'	1.00000162	0.00000014	0.01333208	3.14161362
-38.937	1.5271857	1.00052311	-0.02037	5'	1.00000201	0.00000018	0.01333208	3.14161365
-36.757	1.5271912	1.00064863	-0.02533	5'	1.00000250	0.00000022	0.01333209	3.14161370
-34.578	1.5271978	1.00080070	-0.03150	6'	1.00000310	0.00000027	0.01333210	3.14161375
-32.399	1.5272060	1.00098918	-0.03917	6'	1.00000385	0.00000034	0.01333211	3.14161382
-30.220	1.5272161	1.00122003	-0.04870	6'	1.00000478	0.00000042	0.01333212	3.14161390
-28.041	1.5272283	1.00150117	-0.06056	7'	1.00000592	0.00000052	0.01333214	3.14161400
-25.864	1.5272431	1.00184153	-0.07529	7'	1.00000734	0.00000065	0.01333215	3.14161412
-23.687	1.5272610	1.00225332	-0.09360	8'	1.00000908	0.00000080	0.01333218	3.14161428
-21.511	1.5272824	1.00274643	-0.11636	9'	1.00001123	0.00000099	0.01333221	3.14161447
-19.336	1.5273078	1.00333225	-0.14463	10'	1.00001386	0.00000123	0.01333224	3.14161471
-17.162	1.5273377	1.00402215	-0.17975	11'	1.00001709	0.00000152	0.01333228	3.14161500
-14.990	1.5273725	1.00482673	-0.22336	13'	1.00002103	0.00000188	0.01333234	3.14161536
-12.819	1.5274123	1.00574963	-0.27750	15'	1.00002583	0.00000232	0.01333240	3.14161581
-10.651	1.5274574	1.00679706	-0.34470	17'	1.00003162	0.00000287	0.01333248	3.14161634
-8.484	1.5275075	1.00796198	-0.42808	22'	1.00003862	0.00000353	0.01333257	3.14161701
-6.321	1.5275621	1.00923553	-0.53149	29'	1.00004699	0.00000434	0.01333268	3.14161781
-4.160	1.5276204	1.01059882	-0.65970	44'	1.00005697	0.00000531	0.01333282	3.14161880
-2.002	1.5276814	1.01202956	-0.81861	91'	1.00006872	0.00000649	0.01333297	3.14161997
0.154	1.5277437	1.01349391	-0.98476	316'	1.02120881	0.00000763		
2.306	1.5278059	1.01496058	-0.79409	79'	1.01342946	0.00000642		
4.454	1.5278666	1.01639549	-0.64054	41'	1.01344110	0.00000530		
6.600	1.5279245	1.01776847	-0.51684	28'	1.01345092	0.00000439		
8.743	1.5279785	1.01905371	-0.41715	21'	1.01345914	0.00000363		
10.883	1.5280281	1.02023472	-0.33678	17'	1.01346600	0.00000300		
13.021	1.5280727	1.02129980	-0.27196	14'	1.01347169	0.00000250		
15.157	1.5281121	1.02224278	-0.21966	12'	1.01347639	0.00000208		
17.290	1.5281465	1.02306885	-0.17746	11'	1.01348026	0.00000174		
19.422	1.5281762	1.02378142	-0.14339	10'	1.01348344	0.00000146		
21.552	1.5282015	1.02439010	-0.11587	9'	1.01348604	0.00000124		

23.682	1.5282228	1.0249029 8	-0.09365	8'	1.01348817	0.00000106
25.810	1.5282408	1.0253353 8	-0.07570	7'	1.01348990	0.00000091
27.937	1.5282556	1.0256942 8	-0.06120	7'	1.01349131	0.00000079
30.063	1.5282680	1.0259933 8	-0.04947	6'	1.01349246	0.00000069
32.189	1.5282783	1.0262398 5	-0.04000	6'	1.01349340	0.00000061
34.314	1.5282866	1.0264420 0	-0.03234	6'	1.01349415	0.00000054
36.439	1.5282935	1.0266082 1	-0.02615	5'	1.01349476	0.00000049
38.564	1.5282991	1.0267437 8	-0.02115	5'	1.01349526	0.00000045
40.688	1.5283037	1.0268539 9	-0.01710	5'	1.01349567	0.00000042
42.812	1.5283074	1.0269441 4	-0.01383	5'	1.01349599	0.00000039
44.936	1.5283104	1.0270172 8	-0.01118	5'	1.01349625	0.00000037
47.059	1.5283129	1.0270766 5	-0.00904	4'	1.01349647	0.00000035
49.183	1.5283149	1.0271254 8	-0.00731	4'	1.01349664	0.00000034
51.306	1.5283165	1.0271646 7	-0.00591	4'	1.01349678	0.00000033
52.368	1.5283172	1.0271817 0	-0.00532	4'	1.01349685	0.00000032
53.429	1.5283178	1.0271965 7	-0.00478	4'	1.01349689	0.00000031
54.491	1.5283184	1.0272103 6	-0.00430	4'	1.01349695	0.00000031
55.553	1.5283189	1.0272230 6	-0.00387	4'	1.01349699	0.00000031
57.676	1.5283198	1.0272432 5	-0.00313	4'	1.01349706	0.00000031
59.799	1.5283205	1.0272601 9	-0.00253	4'	1.01349713	0.00000030
61.922	1.5283210	1.0272739 8	-0.00205	3'	1.01349717	0.00000029
64.045	1.5283215	1.0272857 0	-0.00165	3'	1.01349721	0.00000029
66.169	1.5283219	1.0272941 7	-0.00131	3'	1.01349724	0.00000029
68.292	1.5283222	1.0273015 6	-0.00108	3'	1.01349727	0.00000028
70.415	1.5283224	1.0273079 6	-0.00087	3'	1.01349729	0.00000028
72.538	1.5283226	1.0273121 9	-0.00071	3'	1.01349731	0.00000028
74.661	1.5283228	1.0273164 3	-0.00057	3'	1.01349732	0.00000028
76.784	1.5283229	1.0273196 7	-0.00046	3'	1.01349733	0.00000028
78.907	1.5283230	1.0273217 5	-0.00037	3'	1.01349734	0.00000028
81.030	1.5283231	1.0273239 1	-0.00030	3'	1.01349735	0.00000028
83.153	1.5283231	1.0273249 0	-0.00024	3'	1.01349735	0.00000028
85.276	1.5283232	1.0273270 7	-0.00020	3'	1.01349736	0.00000028
87.399	1.5283233	1.0273281 5	-0.00016	3'	1.01349736	0.00000028
89.522	1.5283233	1.0273292 3	-0.00013	3'	1.01349736	0.00000028
91.645	1.5283233	1.0273292 3	-0.00010	2'	1.01349736	0.00000028
93.768	1.5283234	1.0273302 2	-0.00008	2'	1.01349736	0.00000028
95.891	1.5283234	1.0273302 2	-0.00007	2'	1.01349737	0.00000028
98.014	1.5283234	1.0273313 0	-0.00006	2'	1.01349737	0.00000028
100.137	1.5283234	1.0273313 0	-0.00004	2'	1.01349737	0.00000028

OMEGA 3000000 KAPPA 0.1000 DELTA 0.001000 VECTORLENGTH 0.40
REFLECTIONFACTOR 0.0010915 3.1427806 TRANSITFACTOR 1.0021459 0.0000019
ALPHA -0.00146 BETA -0.68292 GAMMA -0.68438

HEIGTH	THETA	E KELLER	ZETA		DISTORTION FUNCTION			
-100.000	1.2217305	1.0000000	-0.00005	2'	1.0000003	0.0000002	0.0019155	3.14278066
-93.160	1.2217305	1.0000018	-0.00009	2'	1.0000006	0.0000004	0.0019155	3.14278068
-86.319	1.2217305	1.0000051	-0.00018	3'	1.0000012	0.0000008	0.0019155	3.14278073
-79.479	1.2217309	1.00000121	-0.00035	3'	1.00000024	0.00000016	0.0019155	3.14278081
-72.638	1.2217314	1.00000262	-0.00070	3'	1.00000048	0.00000033	0.0019155	3.14278097
-65.798	1.2217323	1.00000539	-0.00139	3'	1.00000095	0.00000065	0.0019155	3.14278129
-58.958	1.2217342	1.00001083	-0.00275	4'	1.00000187	0.00000128	0.0019155	3.14278193
-52.117	1.2217378	1.00002160	-0.00545	4'	1.00000371	0.00000254	0.0019155	3.14278318
-45.277	1.2217451	1.00004277	-0.01081	4'	1.00000734	0.00000503	0.0019156	3.14278567
-38.437	1.2217592	1.00008409	-0.02141	5'	1.00001448	0.00000995	0.0019157	3.14279059
-31.597	1.2217863	1.00016351	-0.04244	6'	1.00002851	0.00001964	0.0019158	3.14280029
-24.758	1.2218369	1.00031182	-0.08410	8'	1.00005575	0.00003867	0.0019161	3.14281931
-17.919	1.2219265	1.00057457	-0.16664	11'	1.00010772	0.00007564	0.0019167	3.14285628
-11.083	1.2220712	1.00099924	-0.33013	17'	1.00020366	0.00014627	0.0019177	3.14292691
-4.249	1.2222735	1.00159335	-0.65386	43'	1.00037134	0.00027727	0.0019196	3.14305791
2.582	1.2225058	1.00227636	-0.77247	70'	1.00171709	0.00032427		
9.407	1.2227194	1.00290502	-0.39034	20'	1.00190784	0.00017314		
16.229	1.2228791	1.00337591	-0.19732	12'	1.00201887	0.00009090		
23.048	1.2229813	1.00367713	-0.09978	8'	1.00207975	0.00004756		
29.865	1.2230401	1.00385085	-0.05046	7'	1.00211192	0.00002516		
36.681	1.2230721	1.00394510	-0.02553	5'	1.00212857	-0.00001370		
43.496	1.2230888	1.00399455	-0.01291	5'	1.00213710	0.00000787		
50.311	1.2230974	1.00402004	-0.00653	4'	1.00214144	0.00000491		
57.126	1.2231019	1.00403305	-0.00330	4'	1.00214364	0.00000340		
63.940	1.2231041	1.00403967	-0.00167	3'	1.00214475	0.00000264		
70.755	1.2231052	1.00404303	-0.00085	3'	1.00214532	0.00000226		
77.569	1.2231058	1.00404472	-0.00043	3'	1.00214560	0.00000207		
84.384	1.2231061	1.00404559	-0.00022	3'	1.00214575	0.00000197		
91.198	1.2231062	1.00404603	-0.00011	2'	1.00214582	0.00000192		
98.013	1.2231063	1.00404624	-0.00006	2'	1.00214586	0.00000189		
104.827	1.2231064	1.00404635	-0.00003	2'	1.00214587	0.00000188		

OMEGA 30000000 KAPPA 0.1000 DELTA 0.001000 VECTORLENGTH 0.40
ALPHA -0.00594 BETA -0.16846 GAMMA -0.17440
REFLECTIONFACTOR 0.0336455 3.1420016 TRANSITFACTOR 1.0352931 0.0000136

HEIGTH	THETA	E KELLER	ZETA		DISTORTION FUNCTION			
-100.000	1.4835298	1.00000000	-0.00005	2'	1.0000004	0.0000001	0.0336455 0	3.1420015 7
-96.514	1.4835299	1.00000145	-0.00006	2'	1.0000006	0.0000001	0.03364550	3.14200157
-93.028	1.4835301	1.00000316	-0.00009	2'	1.0000009	0.0000001	0.03364551	3.14200158
-89.541	1.4835303	1.00000564	-0.00013	3'	1.00000012	0.00000002	0.03364551	3.14200158
-86.055	1.4835306	1.00000931	-0.00018	3'	1.00000018	0.00000003	0.03364551	3.14200159
-82.569	1.4835310	1.00001397	-0.00026	3'	1.00000025	0.00000004	0.03364551	3.14200161
-79.083	1.4835316	1.00002107	-0.00037	3'	1.00000036	0.00000006	0.03364551	3.14200162
-75.597	1.4835325	1.00003111	-0.00052	3'	1.00000050	0.00000009	0.03364552	3.14200165
-72.110	1.4835338	1.00004560	-0.00074	3'	1.00000072	0.00000013	0.03364553	3.14200168
-68.624	1.4835355	1.00006569	-0.00105	3'	1.00000101	0.00000018	0.03364554	3.14200173
-65.138	1.4835380	1.00009416	-0.00148	3'	1.00000144	0.00000025	0.03364555	3.14200181
-61.652	1.4835415	1.00013439	-0.00210	3'	1.00000203	0.00000036	0.03364557	3.14200191
-58.167	1.4835465	1.00019156	-0.00298	4'	1.00000289	0.00000051	0.03364560	3.14200206
-54.681	1.4835535	1.00027226	-0.00422	4'	1.00000409	0.00000072	0.03364564	3.14200227
-51.196	1.4835635	1.00038667	-0.00598	4'	1.00000579	0.00000101	0.03364570	3.14200257
-47.711	1.4835775	1.00054775	-0.00847	4'	1.00000820	0.00000143	0.03364578	3.14200299
-44.227	1.4835973	1.00077501	-0.01200	5'	1.00001161	0.00000203	0.03364589	3.14200359
-40.743	1.4836251	1.00109417	-0.01700	5'	1.00001643	0.00000287	0.03364606	3.14200443
-37.261	1.4836639	1.00154150	-0.02409	5'	1.00002323	0.00000406	0.03364628	3.14200562
-33.780	1.4837181	1.00216533	-0.03412	6'	1.00003282	0.00000575	0.03364661	3.14200731
-30.301	1.4837931	1.00302975	-0.04831	6'	1.00004632	0.00000813	0.03364706	3.14200968
-26.825	1.4838958	1.00421710	-0.06839	7'	1.00006524	0.00001147	0.03364770	3.14201304
-23.354	1.4840348	1.00582809	-0.09678	8'	1.00009169	0.00001618	0.03364859	3.14201774
-19.888	1.4842197	1.00797825	-0.13687	10'	1.00012844	0.00002278	0.03364982	3.14202433
-16.429	1.4844599	1.01078705	-0.19342	11'	1.00017916	0.00003197	0.03365153	3.14203352
-12.980	1.4847631	1.01435380	-0.27309	14'	1.00024850	0.00004472	0.03365386	3.14204628
-9.543	1.4851319	1.01872592	-0.38510	19'	1.00034218	0.00006227	0.03365702	3.14206383
-6.120	1.4855610	1.02386098	-0.54226	30'	1.00046699	0.00008623	0.03366121	3.14208779
-2.715	1.4860358	1.02960236	-0.76225	67'	1.00063042	0.00011858	0.03366671	3.14212014
0.672	1.4865327	1.03568157	-0.93505	269'	1.0351239	0.00014765		
4.038	1.4870242	1.04176528	-0.66777	45'	1.0347919	0.00011177		
7.385	1.4874842	1.04752412	-0.47783	25'	1.0348599 6	0.00008521		
10.714	1.4878934	1.05270012	-0.34254	17'	1.0349739 0	0.00006568		
14.026	1.4882415	1.05714402	-0.24596	13'	1.0350590 7	0.00005140		
17.324	1.4885267	1.06081343	-0.17685	11'	1.03512218	0.00004100		
20.612	1.4887534	1.06374859	-0.12731	9'	1.03516863	0.00003344		
23.890	1.4889294	1.06603739	-0.09173	8'	1.03520266	0.00002795		
27.161	1.4890635	1.06778825	-0.06614	7'	1.03522748	0.00002398		
30.426	1.4891642	1.06910750	-0.04771	6'	1.03524554	0.00002110		
33.688	1.4892391	1.07009059	-0.03443	6'	1.03525866	0.00001902		
36.947	1.4892944	1.07081725	-0.02486	5'	1.03526818	0.00001752		
40.203	1.4893350	1.07135058	-0.01795	5'	1.03527507	0.00001643		
43.458	1.4893646	1.07174080	-0.01296	5'	1.03528006	0.00001565		
46.712	1.4893862	1.07202512	-0.00936	4'	1.03528367	0.000015[illegible]7		
49.964	1.4894018	1.07223172	-0.00676	4'	1.03528628	0.00001466		
53.217	1.4894132	1.07238193	-0.00488	4'	1.03528817	0.00001436		
56.468	1.4894215	1.07249074	-0.00353	4'	1.03528953	0.00001415		
59.720	1.4894274	1.07256934	-0.00255	4'	1.03529052	0.00001400		
62.971	1.4894317	1.07262652	-0.00184	3'	1.03529124	0.00001389		
66.222	1.4894349	1.07266767	-0.00133	3'	1.03529175	0.00001381		
69.473	1.4894371	1.07269732	-0.00096	3'	1.03529213	0.00001375		
72.723	1.4894388	1.07271910	-0.00069	3'	1.03529239	0.00001370		
75.974	1.4894399	1.07273449	-0.00050	3'	1.03529258	0.00001367		
79.225	1.4894408	1.07274600	-0.00036	3'	1.03529273	0.00001365		
82.476	1.4894414	1.07275416	-0.00026	3'	1.03529283	0.00001363		
85.726	1.4894419	1.07275992	-0.00019	3'	1.03529290	0.00001363		
88.977	1.4894422	1.07276415	-0.00014	3'	1.03529295	0.00001361		

92.227	1.4894424	1.07276720	-0.00010	2'	1.03529299	0.00001361
95.478	1.4894426	1.07276960	-0.00007	2'	1.03529302	0.00001360
98.728	1.4894427	1.07277113	-0.00005	2'	1.03529304	0.00001360
101.979	1.4894428	1.07277231	-0.00004	2'	1.03529305	0.00001360

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OMEGA 30000000 KAPPA 0.1000 DELTA 0.001000 VECTORLENGTH 0.50
ALPHA -0.01357 BETA -0.07372 GAMMA -0.08728
REFLECTIONFACTOR 0.1824327 3.1418013 TRANSITFACTOR 1.1843669 0.0000323

HEIGTH	THETA	E KELLER	ZETA		DISTORTION FUNCTION			
-100.000	1.5271629	1.00000000	-0.00005	2'	1.00000004	0	0.18243274	3.14180128
-97.819	1.5271631	1.00000290	-0.00006	2'	1.00000006	0	0.18243275	3.14180128
-95.638	1.5271632	1.00000580	-0.00007	2'	1.00000007	0	0.18243275	3.14180129
-93.457	1.5271634	1.00001170	-0.00009	2'	1.00000009	0.00000001	0.18243275	3.14180129
-91.276	1.5271637	1.00001759	-0.00011	2'	1.00000011	0.00000001	0.18243275	3.14180129
-89.095	1.5271640	1.00002442	-0.00014	3'	1.00000013	0.00000001	0.18243276	3.14180129
-86.914	1.5271644	1.00003321	-0.00017	3'	1.00000017	0.00000001	0.18243277	3.14180130
-84.733	1.5271649	1.00004398	-0.00021	3'	1.00000021	0.00000001	0.18243277	3.14180130
-82.552	1.5271654	1.00005671	-0.00026	3'	1.00000026	0.00000002	0.18243278	3.14180131
-80.372	1.5271661	1.00007336	-0.00032	3'	1.00000032	0.00000003	0.18243279	3.14180131
-78.191	1.5271670	1.00009301	-0.00040	3'	1.00000040	0.00000004	0.18243281	3.14180131
-76.010	1.5271681	1.00011940	-0.00050	3'	1.00000050	0.00000004	0.18243283	3.14180133
-73.829	1.5271695	1.00015075	-0.00062	3'	1.00000061	0.00000005	0.18243285	3.14180133
-71.649	1.5271713	1.00019091	-0.00077	3'	1.00000077	0.00000007	0.18243288	3.14180135
-69.468	1.5271734	1.00023986	-0.00096	3'	1.00000096	0.00000008	0.18243291	3.14180136
-67.288	1.5271761	1.00030164	-0.00120	3'	1.00000119	0.00000010	0.18243295	3.14180139
-65.107	1.5271794	1.00037805	-0.00149	3'	1.00000148	0.00000013	0.18243300	3.14180141
-62.927	1.5271835	1.00047216	-0.00185	3'	1.00000184	0.00000016	0.18243307	3.14180144
-60.747	1.5271887	1.00059082	-0.00230	3'	1.00000228	0.00000020	0.18243315	3.14180148
-58.568	1.5271951	1.00073697	-0.00286	4'	1.00000283	0.00000025	0.18243325	3.14180153
-56.388	1.5272030	1.00091851	-0.00356	4'	1.00000353	0.00000031	0.18243338	3.14180159
-54.209	1.5272128	1.00114538	-0.00442	4'	1.00000438	0.00000038	0.18243354	3.14180166
-52.031	1.5272251	1.00142640	-0.00550	4'	1.00000545	0.00000048	0.18243373	3.14180176
-49.853	1.5272402	1.00177468	-0.00684	4'	1.00000678	0.00000059	0.18243397	3.14180187
-47.676	1.5272589	1.00220597	-0.00850	4'	1.00000842	0.00000074	0.18243427	3.14180201
-45.500	1.5272822	1.00274247	-0.01057	4'	1.00001046	0.00000092	0.18243464	3.14180219
-43.325	1.5273110	1.00340646	-0.01314	5'	1.00001299	0.00000113	0.18243511	3.14180242
-41.151	1.5273466	1.00422735	-0.01632	5'	1.00001614	0.00000141	0.18243568	3.14180269
-38.979	1.5273904	1.00524313	-0.02028	5'	1.00002003	0.00000175	0.18243639	3.14180303
-36.810	1.5274446	1.00649840	-0.02520	5'	1.00002485	0.00000218	0.18243727	3.14180346
-34.643	1.5275110	1.00804415	-0.03130	6'	1.00003082	0.00000270	0.18243836	3.14180398
-32.479	1.5275925	1.00994472	-0.03886	6'	1.00003820	0.00000335	0.18243970	3.14180463
-30.319	1.5276919	1.01227628	-0.04822	6'	1.00004729	0.00000415	0.18244136	3.14180543
-28.165	1.5278130	1.01512847	-0.05982	7'	1.00005849	0.00000514	0.18244341	3.14180642
-26.016	1.5279595	1.01860027	-0.07415	7'	1.00007226	0.00000636	0.18244592	3.14180765
-23.875	1.5281358	1.02281211	-0.09186	8'	1.00008914	0.00000787	0.18244900	3.14180915
-21.743	1.5283464	1.02788791	-0.11369	9'	1.00010976	0.00000971	0.18245276	3.14181099
-19.621	1.5285960	1.03396828	-0.14056	10'	1.00013487	0.00001197	0.18245734	3.14181325
-17.512	1.5288887	1.04119373	-0.17357	11'	1.00016528	0.00001472	0.18246289	3.14181601
-15.417	1.5292284	1.04970310	-0.21402	12'	1.00020196	0.00001807	0.18246958	3.14181935
-13.339	1.5296173	1.05961960	-0.26345	14'	1.00024592	0.00002211	0.18247760	3.14182340
-11.281	1.5300562	1.07103852	-0.32366	16'	1.00029829	0.00002699	0.18248715	3.14182827
-9.244	1.5305438	1.08401592	-0.39676	20'	1.00036021	0.00003282	0.18249845	3.14183410
-7.232	1.5310761	1.09854817	-0.48519	25'	1.00043284	0.00003976	0.18251170	3.14184105
-5.247	1.5316470	1.11457253	-0.59175	35'	1.00051737	0.00004797	0.18252712	3.14184925
-3.290	1.5322477	1.13194445	-0.71966	55'	1.00061487	0.00005761	0.18254491	3.14185889
-1.363	1.5328681	1.15046418	-0.87260	133'	1.00072640	0.00006886	0.18256525	3.14187014
0.533	1.5334968	1.16986220	-0.94808	316'	1.18343979	0.00008378		
2.398	1.5341226	1.18982657	-0.78680	76'	1.18357666	0.00007565		
4.231	1.5347348	1.21003115	-0.65501	43'	1.18369365	0.00006884		
6.034	1.5353243	1.23014417	-0.54696	30'	1.18379342	0.00006314		
7.807	1.5358837	1.24985871	-0.45809	24'	1.18387934	0.00005837		
9.552	1.5364076	1.26890352	-0.38473	19'	1.18395052	0.00005437		
11.271	1.5368925	1.28705825	-0.32396	16'	1.18401189	0.00005100		
12.966	1.5373371	1.30416148	-0.27345	14'	1.18406401	0.00004818		
14.639	1.5377406	1.32008586	-0.23134	13'	1.18410831	0.00004579		
16.291	1.5381043	1.33477258	-0.19610	12'	1.18414599	0.00004379		

17.926	1.5384299	1.34820196	-0.16653	11'	1.18417804	0.00004209
19.544	1.5387196	1.36038130	-0.14165	10'	1.18420534	0.00004065
21.147	1.5389762	1.37135202	-0.12067	9'	1.18422861	0.00003943
22.738	1.5392026	1.38118013	-0.10292	8'	1.18424845	0.00003839
24.317	1.5394014	1.38993067	-0.08788	8'	1.18426540	0.00003751
25.887	1.5395756	1.39768583	-0.07512	7'	1.18427987	0.00003676
27.448	1.5397279	1.40453805	-0.06426	7'	1.18429226	0.00003612
29.001	1.5398606	1.41056564	-0.05502	7'	1.18430286	0.00003558
30.547	1.5399762	1.41585447	-0.04714	6'	1.18431193	0.00003511
32.088	1.5400765	1.42047879	-0.04040	6'	1.18431970	0.00003471

OMEGA 30000000 KAPPA 0.1000 DELTA 0.010000 VECTORLENGTH 0.40
REFLECTIONFACTOR 0.0114637 3.1535584 TRANSITFACTOR 1.0222884 0.0001924
ALPHA -0.01487 BETA -0.67259 GAMMA -0.68745

HEIGTH	THETA	E KELLER	ZETA		DISTORTION FUNCTION			
-100.000	1.2217305	1.00000000	-0.00005	2'	1.00000031	0.00000021	0.01146366	3.15355860
-93.160	1.2217311	1.00000177	-0.00009	2'	1.00000061	0.00000042	0.01146367	3.15355881
-86.319	1.2217323	1.00000529	-0.00018	3'	1.00000121	0.00000083	0.01146367	3.15355922
-79.479	1.2217347	1.00001226	-0.00035	3'	1.00000240	0.00000165	0.01146369	3.15356004
-72.639	1.2217394	1.00002607	-0.00070	3'	1.00000476	0.00000327	0.01146371	3.15356166
-65.798	1.2217487	1.00005342	-0.00139	3'	1.00000942	0.00000648	0.01146377	3.15356487
-58.958	1.2217672	1.00010751	-0.00275	4'	1.00001866	0.00001284	0.01146387	3.15357123
-52.119	1.2218036	1.00021430	-0.00545	4'	1.00003695	0.00002543	0.01146408	3.15358382
-45.279	1.2218753	1.00042431	-0.01080	4'	1.00007310	0.00005034	0.01146450	3.15360873
-38.442	1.2220150	1.00083426	-0.02140	5'	1.00014434	0.00009956	0.01146531	3.15365796
-31.607	1.2222836	1.00162305	-0.04240	6'	1.00028400	0.00019653	0.01146692	3.15375493
-24.777	1.2227852	1.00309919	-0.08394	8'	1.00055500	0.00038646	0.01147002	3.15394486
-17.956	1.2236737	1.00572416	-0.16603	11'	1.00107079	0.00075450	0.01147594	3.15431289
-11.152	1.2251099	1.00999530	-0.32784	17'	1.00201944	0.00145386	0.01148681	3.15501226
-4.375	1.2271216	1.01603755	-0.64562	42'	1.00366849	0.00273994	0.01150571	3.15629832
2.364	1.2294440	1.02310044	-0.78950	77'	1.01773082	0.00344866		
9.059	1.2316017	1.02974793	-0.40419	20'	1.01972575	0.00194228		
15.713	1.2332435	1.03486225	-0.20777	12'	1.02089756	0.00111685		
22.337	1.2343160	1.03822992	-0.10713	9'	1.02154938	0.00067622		
28.940	1.2349497	1.04022950	-0.05535	7'	1.02190036	0.00044437		
35.532	1.2353023	1.04134545	-0.02863	6'	1.2208596	0.00032330		
42.116	1.2354920	1.04194694	-0.01482	5'	1.02218314	0.00026032		
48.697	1.2355923	1.04226513	-0.00768	4'	1.02223377	0.00022762		
55.277	1.2356448	1.04243175	-0.00398	4'	1.02226007	0.00021067		
61.855	1.2356722	1.04251856	-0.00206	3'	1.02227372	0.00020188		
68.433	1.2356864	1.04256365	-0.00107	3'	1.02228079	0.00019733		
75.010	1.2356937	1.04258706	-0.00055	3'	1.02228446	0.00019497		
81.587	1.2356975	1.04259919	-0.00029	3'	1.02228636	0.00019374		
88.165	1.2356995	1.04260546	-0.00015	3'	1.02228734	0.00019311		
94.742	1.2357005	1.04260872	-0.00008	2'	1.02228785	0.00019278		
101.319	1.2357011	1.04261041	-0.00004	2'	1.02228811	0.00019261		

OMEGA 30000000 KAPPA 0.1000 DELTA 0.010000 VECTORLENGTH 0.60
ALPHA -0.01628 BETA -0.21608 GAMMA -0.26236
REFLECTIONFACTOR 0.1992735 3.1475971 TRANSITFACTOR 1.2180942 0.0010271

HEIGTH	THETA	E KELLER	ZETA		DISTORTION FUNCTION			
-100.000	1.4398966	1.00000000	-0.00005	2'	1.00000042	0.00000011	0.19927363	3.14759720
-96.084	1.4398974	1.00000622	-0.00007	2'	1.00000063	0.00000016	0.19927367	3.14759725
-92.168	1.4398986	1.00001552	-0.00010	2'	1.00000093	0.00000025	0.19927373	3.14759734
-88.253	1.4399004	1.00002920	-0.00015	3'	1.00000137	0.00000036	0.19927382	3.14759745
-84.337	1.4399030	1.00004952	-0.00022	3'	1.00000203	0.00000054	0.19927395	3.14759763
-80.421	1.4399070	1.00007949	-0.00032	3'	1.00000301	0.00000079	0.19927415	3.14759788
-76.506	1.4399127	1.00012388	-0.00048	3'	1.00000445	0.00000117	0.19927443	3.14759826
-72.591	1.4399213	1.00018952	-0.00070	3'	1.00000658	0.00000173	0.19927486	3.14759882
-68.676	1.4399340	1.00028669	-0.00104	3'	1.00000974	0.00000256	0.19927549	3.14759964
-64.761	1.4399527	1.00043005	-0.00154	3'	1.00001440	0.00000378	0.19927642	3.14760087
-60.847	1.4399803	1.00064217	-0.00228	3'	1.00002129	0.00000559	0.19927779	3.14760268
-56.934	1.4400212	1.00095539	-0.00337	4'	1.00003149	0.00000826	0.19927982	3.14760535
-53.021	1.4400814	1.00141786	-0.00498	4'	1.00004654	0.00001222	0.19928282	3.14760931
-49.111	1.4401701	1.00209961	-0.00736	4'	1.00006877	0.00001806	0.19928725	3.14761515
-45.204	1.4403004	1.00310373	-0.01089	4'	1.00010156	0.00002668	0.19929378	3.14762377
-41.300	1.4404915	1.00457867	-0.01608	5'	1.00014985	0.00003939	0.19930341	3.14763648
-37.402	1.4407703	1.00673871	-0.02375	5'	1.00022085	0.00005811	0.19931756	3.14765520
-33.512	1.4411745	1.00988720	-0.03504	6'	1.00032492	0.00008561	0.19933830	3.14768270
-29.634	1.4417552	1.01444480	-0.05164	7'	1.00047683	0.00012588	0.19936857	3.14772297
-25.774	1.4425787	1.02097863	-0.07597	7'	1.00069724	0.00018459	0.19941249	3.14778168
-21.938	1.4437254	1.03021735	-0.11150	9'	1.00101435	0.00026964	0.19947568	3.14786673
-18.136	1.4452827	1.04303478	-0.16307	10'	1.00146534	0.00039174	0.19956555	3.14798883
-14.380	1.4473292	1.06036882	-0.23740	13'	1.00209688	0.00056500	0.19969140	3.14816210
-10.686	1.4499082	1.08304781	-0.34350	17'	1.00296392	0.00080709	0.19986418	3.14840418
-7.068	1.4529984	1.11152834	-0.49323	26'	1.00412586	0.00113901	0.20009572	3.14873610
-3.542	1.4564957	1.14561736	-0.70174	51'	1.00564035	0.00158418	0.20039752	3.14918127
-0.120	1.4602227	1.18431532	-0.98803	316'	1.02921059	0.00205835	0.20509445	3.14965544
3.190	1.4639666	1.22590341	-0.72687	57'	1.21072536	0.00213829		
6.389	1.4675295	1.26827908	-0.52788	29'	1.21253935	0.00184955		
9.481	1.4707663	1.30939188	-0.38746	20'	1.21389978	0.00163940		
12.477	1.4735978	1.34759798	-0.28716	15'	1.21491828	0.00148572		
15.389	1.4760019	1.38182917	-0.21463	12'	1.21568173	0.00137261		
18.228	1.4779975	1.41158843	-0.16157	10'	1.21625571	0.00128875		
21.008	1.4796258	1.43683629	-0.12236	9'	1.21668891	0.00122613		
23.739	1.4809377	1.45784183	-0.09311	8'	1.21701720	0.00117908		
26.432	1.4819846	1.47504975	-0.07114	7'	1.21726694	0.00114351		
29.092	1.4828141	1.48897595	-0.05452	7'	1.21745759	0.00111648		
31.729	1.4834680	1.50013965	-0.04188	6'	1.21760356	0.00109588		
34.345	1.4839814	1.50902196	-0.03224	6'	1.21771558	0.00108010		
36.946	1.4843832	1.51604795	-0.02486	5'	1.21780175	0.00106800		
39.535	1.4846971	1.52158082	-0.01919	5'	1.21786813	0.00105869		
42.115	1.4849417	1.52592216	-0.01482	5'	1.21791934	0.00105152		
44.688	1.4851322	1.52931964	-0.01146	5'	1.21795888	0.00104599		
47.254	1.4852804	1.53197262	-0.00887	4'	1.21798944	0.00104172		
49.817	1.4853955	1.53401089	-0.00686	4'	1.21801308	0.00103842		
52.376	1.4854850	1.53565128	-0.00531	4'	1.21803136	0.00103586		
54.932	1.4855544	1.53690371	-0.00411	4'	1.21804552	0.00103389		
57.486	1.4856083	1.53787734	-0.00319	4'	1.21805647	0.00103236		
60.039	1.4856501	1.53863285	-0.00247	4'	1.21806497	0.00103118		
62.590	1.4856826	1.53922006	-0.00191	3'	1.21807155	0.00103026		
65.140	1.4857077	1.53967570	-0.00148	3'	1.21807664	0.00102954		
67.690	1.4857272	1.54002963	-0.00115	3'	1.21808059	0.00102899		
70.239	1.4857423	1.54030342	-0.00089	3'	1.21808365	0.00102857		
72.787	1.4857541	1.54051614	-0.00069	3'	1.21808602	0.00102824		
75.336	1.4857632	1.54068129	-0.00053	3'	1.21808785	0.00102798		
77.884	1.4857702	1.54080936	-0.00041	3'	1.21808927	0.00102779		
80.431	1.4857757	1.54090845	-0.00032	3'	1.21809038	0.00102763		

82.979	1.4857799	1.54098532	-0.00025	3'	1.21809123	0.00102751
85.526	1.4857832	1.54104501	-0.00019	3'	1.21809189	0.00102742
88.074	1.4857857	1.54109079	-0.00015	3'	1.21809241	0.00102735
90.621	1.4857877	1.54112703	-0.00012	2'	1.21809281	0.00102729
93.168	1.4857893	1.54115489	-0.00009	2'	1.21809312	0.00102725
95.715	1.4857904	1.54117599	-0.00007	2'	1.21809336	0.00102721
98.262	1.4857914	1.54119276	-0.00005	2'	1.21809354	0.00102719
100.809	1.4857921	1.54120588	-0.00004	2'	1.21809369	0.00102717

OMEGA 3000000 KAPPA 0.1000 DELTA 0.100000 VECTORLENGTH 0.40
REFLECTIONFACTOR 0.2490866 3.2699134 TRANSITFACTOR 1.4095337 0.0296970
ALPHA -0.18937 BETA -0.52807 GAMMA -0.71744

HEIGTH	THETA	E KELLER	ZETA		DISTORTION FUNCTION			
-100.000	1.2217305	1.00000000	-0.00005	2'	1.00000300	0.00000215	0.24908735	3.26991554
-93.160	1.2217360	1.00001629	-0.00009	2'	1.00000594	0.00000426	0.24908808	3.26991766
-86.319	1.2217471	1.00004860	-0.00018	3'	1.00001177	0.00000845	0.24908959	3.26992184
-79.479	1.2217689	1.00011263	-0.00035	3'	1.00002333	0.00001673	0.24909241	3.26993013
-72.640	1.2218122	1.00023952	-0.00070	3'	1.00004623	0.00003317	0.24909811	3.26994656
-65.801	1.2218979	1.00049078	-0.00139	3'	1.00009158	0.00006571	0.24910941	3.26997911
-58.963	1.2220674	1.00098810	-0.00275	4'	1.00018137	0.00013015	0.24913178	3.27004355
-52.129	1.2224021	1.00197116	-0.00545	4'	1.00035893	0.00025765	0.24917600	3.27017105
-45.302	1.2230600	1.00390942	-0.01078	4'	1.00070932	0.00050944	0.24926328	3.27042284
-38.486	1.2243436	1.00771197	-0.02131	5'	1.00139784	0.00100502	0.24943478	3.27091841
-31.695	1.2268108	1.01509959	-0.04203	6'	1.00273991	0.00197396	0.24976907	3.27188736
-24.950	1.2314211	1.02918829	-0.08250	8'	1.00531560	0.00384454	0.25041064	3.27375793
-18.292	1.2396050	1.05515201	-0.16054	10'	1.01012021	0.00737192	0.25160741	3.27728532
-11.789	1.2529264	1.10024006	-0.30763	16'	1.01865401	0.01375667	0.25373306	3.28367008
-5.538	1.2719592	1.17155771	-0.57477	33'	1.03270330	0.02458925	0.25723255	3.29450263
0.350	1.2949883	1.27088415	-0.96557	316'	1.31245367	0.05718356		
5.797	1.3184428	1.39052815	-0.56007	32'	1.34824196	0.04603644		
10.791	1.3391415	1.51610502	-0.33992	17'	1.37034681	0.03976201		
15.382	1.3557091	1.63393930	-0.21476	12'	1.38396788	0.03611392		
19.651	1.3682330	1.73574659	-0.14014	10'	1.39251122	0.03390804		
23.675	1.3774165	1.81874615	-0.09372	8'	1.39800167	0.03252327		
27.518	1.3840484	1.88374288	-0.06381	7'	1.40161439	0.03162594		
31.231	1.3888024	1.93323963	-0.04402	6'	1.40403945	0.03102974		
34.851	1.3921982	1.97020526	-0.03065	6'	1.40569310	0.03062599		
38.404	1.3946202	1.99743748	-0.02148	5'	1.40683432	0.03034968		
41.910	1.3963464	2.01730724	-0.01513	5'	1.40762892	0.03015623		
45.381	1.3975765	2.03170647	-0.01069	4'	1.40818579	0.03002167		
48.828	1.3984529	2.04209121	-0.00758	4'	1.40857792	0.02992707		
52.258	1.3990774	2.04955506	-0.00538	4'	1.40885498	0.02986031		
55.675	1.3995223	2.05490670	-0.00382	4'	1.40905124	0.02981306		
59.084	1.3998394	2.05873696	-0.00272	4'	1.40919048	0.02977955		
62.487	1.4000654	2.06147515	-0.00193	3'	1.40928941	0.02975576		
65.885	1.4002264	2.06343097	-0.00138	3'	1.40935976	0.02973884		
69.280	1.4003411	2.06482697	-0.00098	3'	1.40940982	0.02972680		
72.672	1.4004229	2.06582303	-0.00070	3'	1.40944545	0.02971824		
76.063	1.4004812	2.06653342	-0.00050	3'	1.40947082	0.02971214		
79.453	1.4005227	2.06704004	-0.00035	3'	1.40948891	0.02970780		
82.842	1.4005523	2.06740109	-0.00025	3'	1.40950178	0.02970470		
86.231	1.4005734	2.06765876	-0.00018	3'	1.40951095	0.02970250		
89.619	1.4005885	2.06784227	-0.00013	3'	1.40951749	0.02970093		
93.006	1.4005992	2.06797317	-0.00009	2'	1.40952215	0.02969981		
96.394	1.4006068	2.06806638	-0.00007	2'	1.40952547	0.02969901		
99.781	1.4006123	2.06813285	-0.00005	2'	1.40952783	0.02969844		
103.168	1.4006161	2.06818017	-0.00003	2'	1.40952951	0.02969804		

OMEGA 30000000 KAPPA 10.0000 DELTA 0.000010 VECTORLENGTH 0.21
REFLECTIONFACTOR 0.0000025 3.1415926 TRANSITFACTOR 1.0000025 0
ALPHA -0.00000 BETA -0.02000 GAMMA -0.02000

HEIGTH	THETA	E KELLER	ZETA		DISTORTION FUNCTION			
-1.000	0	1.00000000	-0.00005	2'	1.00000000	0	0.0000250	3.14159264
-0.898	0	1.00000000	-0.00013	3'	1.00000000	0	0.0000250	3.14159264
-0.795	0	1.00000000	-0.00035	3'	1.00000000	0	0.0000250	3.14159264
-0.692	0	1.00000000	-0.00098	3'	1.00000000	0	0.0000250	3.14159264
-0.590	0	1.00000000	-0.00274	4'	1.00000000	6.28318530	0.0000250	3.14159264
-0.487	0	1.00000001	-0.00764	4'	1.00000000	6.28318530	0.0000250	3.14159264
-0.385	0	1.00000005	-0.02128	5'	1.00000000	6.28318530	0.0000250	3.14159264
-0.282	0	1.00000014	-0.05931	7'	1.00000000	6.28318530	0.0000250	3.14159264
-0.180	0	1.00000035	-0.16530	11'	1.00000000	6.28318530	0.0000250	3.14159264
-0.077	0	1.00000079	-0.46070	24'	1.00000000	6.28318530	0.0000250	3.14159264
0.025	0	1.00000140	-0.77880	73'	1.00000250	6.28318530		
0.128	0	1.00000195	-0.27943	15'	1.00000250	6.28318530		
0.230	0	1.00000227	-0.10026	8'	1.00000250	6.28318530		
0.333	0	1.00000241	-0.03597	6'	1.00000250	0		
0.435	0	1.00000246	-0.01291	5'	1.00000250	0		
0.538	0	1.00000248	-0.00463	4'	1.00000250	0		
0.640	0	1.00000250	-0.00166	3'	1.00000250	0		
0.743	0	1.00000250	-0.00060	3'	1.00000250	0		
0.845	0	1.00000250	-0.00021	3'	1.00000250	0		
0.948	0	1.00000250	-0.00008	2'	1.00000250	0		
1.050	0	1.00000250	-0.00003	2'	1.00000250	0		

OMEGA 3ooooooo KAPPA 1o.oooo DELTA o.ooo01o VECTORLENGTH o.2o
REFLECTIONFACTOR o.oooo026 3.1415927 TRANSITFACTOR 1.oooo026 o
ALPHA -o.ooooo BETA -o.o197o GAMMA -o.o197o

HEIGTH	THETA	E KELLER	ZETA		DISTORTION FUNCTION			
-1.ooo	o.1745329	1.oooooooo	-o.ooo05	2'	1.oooooooo	6.283185o3o	o.ooooo258	3.14159265
-o.9o2	o.1745329	1.oooooooo	-o.ooo12	2'	1.oooooooo	6.2831853o	o.ooooo258	3.14159265
-o.8o3	o.1745329	1.oooooooo	-o.ooo33	3'	1.oooooooo	6.2831853o	o.ooooo258	3.14159265
-o.7o5	o.1745329	1.oooooooo	-o.ooo87	3'	1.oooooooo	6.2831853o	o.ooooo258	3.14159265
-o.6o6	o.1745329	1.oooooooo	-o.oo233	3'	1.oooooooo	6.2831853o	o.ooooo258	3.14159265
-o.5o8	o.1745329	1.ooooooo1	-o.oo625	4'	1.oooooooo	6.2831853o	o.ooooo258	3.14159265
-o.4o9	o.1745329	1.ooooooo4	-o.o1672	5'	1.oooooooo	6.2831853o	o.ooooo258	3.14159265
-o.311	o.174533o	1.oooooo11	-o.o4476	6'	1.oooooooo	6.2831853o	o.ooooo258	3.14159265
-o.212	o.174533o	1.oooooo28	-o.11985	9'	1.oooooooo	6.2831853o	o.ooooo258	3.14159265
-o.114	o.1745331	1.oooooo64	-o.32o87	16'	1.oooooooo	6.2831853o	o.ooooo258	3.14159265
-o.o15	o.1745333	1.ooooo122	-o.859o5	119'	o.9999999o	6.2831853o	o.ooooo258	3.14159265
o.o83	o.1745335	1.ooooo185	-o.4347o	22'	1.ooooo261	o		
o.182	o.1745337	1.ooooo228	-o.1624o	1o'	1.ooooo26o	o		
o.28o	o.1745338	1.ooooo25o	-o.o6o66	7'	1.ooooo26o	o		
o.379	o.1745338	1.ooooo26o	-o.o2266	5'	1.ooooo26o	o		
o.477	o.1745338	1.ooooo263	-o.oo846	4'	1.ooooo26o	o		
o.576	o.1745338	1.ooooo264	-o.oo316	4'	1.ooooo26o	o		
o.674	o.1745338	1.ooooo265	-o.oo118	3'	1.ooooo26o	o		
o.773	o.1745338	1.ooooo266	-o.ooo44	3'	1.ooooo26o	o		
o.871	o.1745338	1.ooooo266	-o.ooo16	3'	1.ooooo26o	o		
o.97o	o.1745338	1.ooooo266	-o.oooo6	2'	1.ooooo26o	o		
1.o68	o.1745338	1.ooooo266	-o.oooo2	2'	1.ooooo26o	o		

OMEGA 3000000 KAPPA 10.0000 DELTA 0.000010 VECTORLENGTH 0.40
REFLECTIONFACTOR 0.0000214 3.1415927 TRANSITFACTOR 1.0000214 0
ALPHA -0.00000 BETA -0.00684 GAMMA -0.00684

HEIGTH	THETA	E KELLER	ZETA		DISTORTION FUNCTION			
-1.000	1.2217305	1.00000000	-0.00005	2'	1.00000000	0	0.00002137	3.14159265
-0.932	1.2217305	1.00000000	-0.00009	2'	1.00000000	0	0.00002137	3.14159265
-0.863	1.2217305	1.00000000	-0.00018	3'	1.00000000	0	0.00002137	3.14159265
-0.795	1.2217305	1.00000001	-0.00035	3'	1.00000000	0	0.00002137	3.14159265
-0.726	1.2217305	1.00000003	-0.00070	3'	1.00000000	0	0.00002137	3.14159265
-0.658	1.2217305	1.00000004	-0.00139	3'	1.00000000	0	0.00002137	3.14159265
-0.590	1.2217305	1.00000010	-0.00275	4'	1.00000000	6.28318530	0.00002137	3.14159265
-0.521	1.2217305	1.00000020	-0.00545	4'	1.00000000	6.28318530	0.00002137	3.14159265
-0.453	1.2217306	1.00000042	-0.01081	4'	1.00000000	6.28318530	0.00002137	3.14159265
-0.384	1.2217308	1.00000084	-0.02142	5'	1.00000000	6.28318530	0.00002137	3.14159265
-0.316	1.2217310	1.00000163	-0.04244	6'	1.00000000	6.28318530	0.00002137	3.14159265
-0.248	1.2217315	1.00000312	-0.08412	8'	1.00000000	6.28318530	0.00002137	3.14159265
-0.179	1.2217324	1.00000573	-0.16671	11'	1.00000000	6.28318530	0.00002137	3.14159265
-0.111	1.2217339	1.00000998	-0.33039	17'	0.99999999	6.28318530	0.00002137	3.14159265
-0.042	1.2217359	1.00001592	-0.65478	43'	0.99999999	6.28318530	0.00002137	3.14159265
0.026	1.2217382	1.00002272	-0.77060	70'	1.00002141	6.28318530		
0.094	1.2217403	1.00002895	-0.38883	20'	1.00002140	6.28318530		
0.163	1.2217419	1.00003354	-0.19520	12'	1.00002140	6.28318530		
0.231	1.2217430	1.00003660	-0.09900	8'	1.00002140	6.28318530		
0.300	1.2217435	1.00003831	-0.04995	7'	1.00002140	6.28318530		
0.368	1.2217439	1.00003924	-0.02521	5'	1.00002140	6.28318530		
0.436	1.2217440	1.00003972	-0.01272	5'	1.00002140	6.28318530		
0.505	1.2217441	1.00003997	-0.00642	4'	1.00002139	6.28318530		
0.573	1.2217442	1.00004010	-0.00324	4'	1.00002140	6.28318530		
0.642	1.2217442	1.00004017	-0.00163	3'	1.00002140	0		
0.710	1.2217442	1.00004020	-0.00082	3'	1.00002140	0		
0.778	1.2217442	1.00004023	-0.00042	3'	1.00002140	0		
0.847	1.2217442	1.00004024	-0.00021	3'	1.00002140	0		
0.915	1.2217442	1.00004024	-0.00011	2'	1.00002140	0		
0.984	1.2217442	1.00004024	-0.00005	2'	1.00002140	0		
1.052	1.2217442	1.00004024	-0.00003	2'	1.00002140	0		

OMEGA 3000000 KAPPA 10.0000 DELTA 0.000100 VECTORLENGTH 0.40
REFLECTIONFACTOR 0.0002138 3.1415926 TRANSITFACTOR 1.0002138 0
ALPHA -0.00000 BETA -0.00684 GAMMA -0.00684

HEIGTH	THETA	E KELLER	ZETA		DISTORTION FUNCTION			
-1.000	1.2217305	1.00000000	-0.00005	2'	1.0000000	0	0.00021377	3.14159264
-0.932	1.2217305	1.00000002	-0.00009	2'	1.0000000	0	0.00021377	3.14159264
-0.863	1.2217305	1.00000005	-0.00018	3'	1.0000000	0	0.00021377	3.14159264
-0.795	1.2217305	1.00000011	-0.00035	3'	1.0000000	0	0.00021377	3.14159264
-0.726	1.2217306	1.00000025	-0.00070	3'	1.0000000	0	0.00021377	3.14159264
-0.658	1.2217307	1.00000054	-0.00139	3'	1.0000000	0	0.00021377	3.14159264
-0.590	1.2217308	1.00000107	-0.00275	4'	1.0000000	0	0.00021377	3.14159264
-0.521	1.2217312	1.00000215	-0.00545	4'	1.0000000	0	0.00021377	3.14159264
-0.453	1.2217319	1.00000428	-0.01081	4'	1.0000000	0	0.00021377	3.14159264
-0.384	1.2217333	1.00000840	-0.02142	5'	1.0000000	0	0.00021377	3.14159264
-0.316	1.2217361	1.00001636	-0.04244	6'	1.0000000	0	0.00021377	3.14159264
-0.248	1.2217411	1.00003119	-0.08411	8'	1.0000000	0	0.00021377	3.14159264
-0.179	1.2217501	1.00005747	-0.16670	11'	1.0000001	0	0.00021377	3.14159264
-0.111	1.2217646	1.00009990	-0.33037	17'	1.0000000	0	0.00021377	3.14159264
-0.042	1.2217848	1.00015922	-0.65470	43'	1.0000000	0	0.00021377	3.14159264
0.026	1.2218080	1.00022730	-0.77077	70'	1.00021381	0		
0.094	1.2218294	1.00028981	-0.38897	20'	1.00021380	0		
0.163	1.2218453	1.00033652	-0.19630	12'	1.00021379	0		
0.231	1.2218555	1.00036631	-0.09907	8'	1.00021380	0		
0.300	1.2218613	1.00038344	-0.05000	7'	1.00021379	0		
0.368	1.2218645	1.00039270	-0.02523	5'	1.00021379	0		
0.436	1.2218661	1.00039756	-0.01274	5'	1.00021379	0		
0.505	1.2218670	1.00040006	-0.00643	4'	1.00021379	0		
0.573	1.2218674	1.00040133	-0.00324	4'	1.00021379	0		
0.641	1.2218676	1.00040196	-0.00164	3'	1.00021379	0		
0.710	1.2218677	1.00040231	-0.00083	3'	1.00021379	0		
0.778	1.2218678	1.00040247	-0.00042	3'	1.00021379	0		
0.847	1.2218678	1.00040254	-0.00021	3'	1.00021379	0		
0.915	1.2218678	1.00040257	-0.00011	2'	1.00021379	0		
0.983	1.2218678	1.00040261	-0.00005	2'	1.00021379	0		
1.052	1.2218679	1.00040264	-0.00003	2'	1.00021379	0		

OMEGA 3000000 KAPPA 10.0000 DELTA 0.001000 VECTORLENGTH 0.40
REFLECTIONFACTOR 0.0021440 3.1415926 TRANSITFACTOR 1.0021442 0
ALPHA -0.00001 BETA -0.00683 GAMMA -0.00684

HEIGTH	THETA	E KELLER	ZETA		DISTORTION FUNCTION			
-1.000	1.2217305	1.00000000	-0.00005	2'	1.00000000	0	0.00214402	3.14159264
-0.932	1.2217305	1.00000018	-0.00009	2'	1.00000000	0	0.00214402	3.14159264
-0.863	1.2217306	1.00000051	-0.00018	3'	1.00000000	0	0.00214402	3.14159264
-0.795	1.2217309	1.00000121	-0.00035	3'	1.00000000	0	0.00214402	3.14159264
-0.726	1.2217314	1.00000262	-0.00070	3'	1.00000000	0	0.00214402	3.14159264
-0.658	1.2217323	1.00000539	-0.00139	3'	1.00000000	0	0.00214402	3.14159264
-0.590	1.2217342	1.00001083	-0.00275	4'	1.00000000	0	0.00214402	3.14159264
-0.521	1.2217378	1.00002160	-0.00545	4'	1.00000000	0	0.00214402	3.14159264
-0.453	1.2217451	1.00004277	-0.01081	4'	1.00000000	0	0.00214402	3.14159264
-0.384	1.2217592	1.00008409	-0.02141	5'	1.00000000	0	0.00214402	3.14159264
-0.316	1.2217863	1.00016351	-0.04244	6'	1.00000000	0	0.00214402	3.14159264
-0.248	1.2218369	1.00031182	-0.08410	8'	1.00000001	0	0.00214402	3.14159264
-0.179	1.2219265	1.00057457	-0.16664	11'	1.00000001	0	0.00214402	3.14159264
-0.111	1.2220712	1.00099924	-0.33013	17'	1.00000003	0	0.00214402	3.14159264
-0.042	1.2222735	1.00159335	-0.65386	43'	1.00000005	0	0.00214402	3.14159264
0.026	1.2225058	1.00227636	-0.77247	70'	1.00214415	0		
0.094	1.2227194	1.00290502	-0.39034	20'	1.00214417	0		
0.162	1.2228791	1.00337591	-0.19732	12'	1.00214418	0		
0.230	1.2229813	1.00367713	-0.09978	8'	1.00214419	0		
0.299	1.2230401	1.00385085	-0.05046	7'	1.00214419	0		
0.367	1.2230721	1.00394510	-0.02553	5'	1.00214420	0		
0.435	1.2230888	1.00399455	-0.01291	5'	1.00214420	0		
0.503	1.2230974	1.00402004	-0.00653	4'	1.00214419	0		
0.571	1.2231019	1.00403305	-0.00330	4'	1.00214420	0		
0.639	1.2231041	1.00403967	-0.00167	3'	1.00214419	0		
0.708	1.2231052	1.00404303	-0.00085	3'	1.00214420	0		
0.776	1.2231058	1.00404472	-0.00043	3'	1.00214420	0		
0.844	1.2231061	1.00404559	-0.00022	3'	1.00214420	0		
0.912	1.2231062	1.00404603	-0.00011	2'	1.00214420	0		
0.980	1.2231063	1.00404624	-0.00006	2'	1.00214420	0		
1.048	1.2231064	1.00404635	-0.00003	2'	1.00214420	0		

OMEGA 3000000 KAPPA 10.0000 DELTA 0.010000 VECTORLENGTH 0.4
REFLECTIONFACTOR 0.0221041 3.1415927 TRANSITFACTOR 1.0221058 0
ALPHA -0.00015 BETA -0.00673 GAMMA -0.00687

HEIGTH	THETA	E KELLER	ZETA		DISTORTION FUNCTION			
-1.000	1.2217305	1.00000000	-0.00005	2'	1.0000000	0	0.0221041	3.14159267
-0.932	1.2217311	1.00000177	-0.00009	2'	1.0000000	0	0.0221041	3.14159267
-0.863	1.2217323	1.00000529	-0.00018	3'	1.0000000	0	0.0221041	3.14159267
-0.795	1.2217347	1.00001226	-0.00035	3'	1.0000000	0	0.0221041	3.14159267
-0.726	1.2217394	1.00002607	-0.00070	3'	1.0000000	0	0.0221041	3.14159267
-0.658	1.2217487	1.00005342	-0.00139	3'	1.0000000	0	0.0221041	3.14159267
-0.590	1.2217672	1.00010751	-0.00275	4'	1.0000000	0	0.0221041	3.14159267
-0.521	1.2218036	1.00021430	-0.00545	4'	1.0000001	0	0.0221041	3.14159267
-0.453	1.2218753	1.00042431	-0.01080	4'	1.0000001	0	0.0221041	3.14159267
-0.384	1.2220150	1.00083426	-0.02140	5'	1.0000002	0	0.0221041	3.14159267
-0.316	1.2222836	1.00162305	-0.04240	6'	1.0000004	0	0.0221041	3.14159267
-0.248	1.2227852	1.00309919	-0.08394	8'	1.0000008	0	0.0221041	3.14159267
-0.180	1.2236737	1.00572416	-0.16603	11'	1.0000016	0	0.0221042	3.14159267
-0.112	1.2251099	1.00999530	-0.32784	17'	1.0000031	0	0.0221042	3.14159267
-0.044	1.2271216	1.01603755	-0.64562	42'	1.0000056	0	0.0221043	3.14159267
0.024	1.2294410	1.02310044	-0.78950	77'	1.0221051	0		
0.091	1.2316017	1.02974793	-0.40419	20'	1.0221054	0		
0.157	1.2332435	1.03486225	-0.20777	12'	1.0221055	0		
0.223	1.2343160	1.03822992	-0.10713	9'	1.0221056	0		
0.289	1.2349497	1.04022950	-0.05535	7'	1.0221057	0		
0.355	1.2353023	1.04134545	-0.02863	6'	1.0221057	0		
0.421	1.2354920	1.04194694	-0.01482	5'	1.0221057	0		
0.487	1.2355923	1.04226513	-0.00768	4'	1.0221057	0		
0.553	1.2356448	1.04243175	-0.00398	4'	1.0221057	0		
0.619	1.2356722	1.04251856	-0.00206	3'	1.0221057	0		
0.684	1.2356864	1.04256365	-0.00107	3'	1.0221057	0		
0.750	1.2356937	1.04258706	-0.00055	3'	1.0221057	0		
0.816	1.2356975	1.04259919	-0.00029	3'	1.0221057	0		
0.882	1.2356995	1.04260546	-0.00015	3'	1.0221057	0		
0.947	1.2357005	1.04260872	-0.00008	2'	1.0221057	0		
1.013	1.2357011	1.04261041	-0.00004	2'	1.0221057	0		

OMEGA 3000000 KAPPA 10.0000 DELTA 0.010000 VECTORLENGTH 0.60
ALPHA -0.00046 BETA -0.00216 GAMMA -0.00262
REFLECTIONFACTOR 0.2141776 3.1415927 TRANSITFACTOR 1.2141797 0

HEISTH	THETA	E KELLER	ZETA		DISTORTION FUNCTION			
-1.000	1.4398956	1.00000000	-0.00005	2'	1.00000000	0	0.21417765	3.14159267
-0.961	1.4398974	1.00000622	-0.00007	2'	1.00000000	0	0.21417765	3.14159267
-0.922	1.4398986	1.00001552	-0.00010	2'	1.00000000	0	0.21417765	3.14159267
-0.883	1.4399004	1.00002920	-0.00015	3'	1.00000000	0	0.21417765	3.14159267
-0.843	1.4399030	1.00004952	-0.00022	3'	1.00000000	0	0.21417765	3.14159267
-0.804	1.4399070	1.00007949	-0.00032	3'	1.00000000	0	0.21417765	3.14159267
-0.765	1.4399127	1.00012388	-0.00048	3'	1.00000000	0	0.21417765	3.14159267
-0.726	1.4399213	1.00018952	-0.00070	3'	1.00000000	0	0.21417765	3.14159267
-0.687	1.4399340	1.00028669	-0.00104	3'	1.00000000	0	0.21417765	3.14159267
-0.648	1.4399527	1.00043005	-0.00154	3'	1.00000000	0	0.21417765	3.14159267
-0.608	1.4399803	1.00064217	-0.00228	3'	1.00000000	0	0.21417765	3.14159267
-0.569	1.4400212	1.00095539	-0.00337	4'	1.00000000	0	0.21417765	3.14159267
-0.530	1.4400814	1.00141786	-0.00498	4'	1.00000000	0	0.21417765	3.14159267
-0.491	1.4401701	1.00209961	-0.00736	4'	1.00000001	0	0.21417765	3.14159267
-0.452	1.4403004	1.00310373	-0.01089	4'	1.00000001	0	0.21417765	3.14159267
-0.413	1.4404915	1.00457867	-0.01608	5'	1.00000001	0	0.21417765	3.14159267
-0.374	1.4407703	1.00673871	-0.02375	5'	1.00000003	0	0.21417765	3.14159267
-0.335	1.4411745	1.00988720	-0.03504	6'	1.00000004	0	0.21417766	3.14159267
-0.296	1.4417552	1.01444480	-0.05164	7'	1.00000005	0	0.21417766	3.14159267
-0.258	1.4425787	1.02097863	-0.07597	7'	1.00000007	0	0.21417766	3.14159267
-0.219	1.4437254	1.03021735	-0.11150	9'	1.00000011	0	0.21417767	3.14159267
-0.181	1.4452827	1.04303478	-0.16307	10'	1.00000015	0	0.21417768	3.14159267
-0.144	1.4473292	1.06036882	-0.23740	13'	1.00000022	0	0.21417769	3.14159267
-0.107	1.4490082	1.08304781	-0.34350	17'	1.00000031	0	0.21417771	3.14159267
-0.071	1.4529984	1.11152834	-0.49323	26'	1.00000046	0	0.21417774	3.14159267
-0.035	1.4564957	1.14561736	-0.70174	51'	1.00000060	0	0.21417778	3.14159267
-0.001	1.4602227	1.18431532	-0.98803	316'	1.02199932	0	0.21888941	3.14159267
0.032	1.4639666	1.22590341	-0.72687	57'	1.21417891	0		
0.064	1.4675295	1.26827908	-0.52788	29'	1.21417908	0		
0.095	1.4707663	1.30939188	-0.38746	20'	1.21417923	0		
0.125	1.4735978	1.34759798	-0.28716	15'	1.21417934	0		
0.154	1.4760019	1.38182917	-0.21463	12'	1.21417941	0		
0.182	1.4779975	1.41158843	-0.16157	10'	1.21417947	0		
0.210	1.4796258	1.43683629	-0.12236	9'	1.21417952	0		
0.237	1.4800377	1.45784183	-0.09311	8'	1.21417955	0		
0.264	1.4819846	1.47504975	-0.07114	7'	1.21417957	0		
0.291	1.4828141	1.48897595	-0.05452	7'	1.21417960	0		
0.317	1.4834680	1.50013965	-0.04188	6'	1.21417961	0		
0.343	1.4839814	1.50902196	-0.03224	6'	1.21417962	0		
0.369	1.4843832	1.51604795	-0.02486	5'	1.21417962	0		
0.395	1.4846971	1.52158032	-0.01919	5'	1.21417964	0		
0.421	1.4849417	1.52592216	-0.01482	5'	1.21417964	0		
0.447	1.4851322	1.52931964	-0.01146	5'	1.21417965	0		
0.473	1.4852804	1.53197262	-0.00887	4'	1.21417965	0		
0.498	1.4853955	1.53404089	-0.00686	4'	1.21417965	0		
0.524	1.4854850	1.53565128	-0.00531	4'	1.21417965	0		
0.549	1.4855544	1.53690371	-0.00411	4'	1.21417965	0		
0.575	1.4856083	1.53787734	-0.00319	4'	1.21417965	0		
0.600	1.4856501	1.53863285	-0.00247	4'	1.21417966	0		
0.626	1.4856826	1.53922006	-0.00191	3'	1.21417966	0		
0.651	1.4857077	1.53967570	-0.00148	3'	1.21417965	0		
0.677	1.4857272	1.54002963	-0.00115	3'	1.21417966	0		
0.702	1.4857423	1.54030342	-0.00089	3'	1.21417966	0		
0.728	1.4857541	1.54051614	-0.00069	3'	1.21417966	0		
0.753	1.4857632	1.54068129	-0.00053	3'	1.21417966	0		
0.779	1.4857702	1.54080936	-0.00041	3'	1.21417966	0		
0.804	1.4857757	1.54090845	-0.00032	3'	1.21417965	0		

o.830	1.4857709	1.54098532	-o.00025	3'	1.21417965	o
o.855	1.4857732	1.54104501	-o.00019	3'	1.21417966	o
o.881	1.4857757	1.54109079	-o.00015	3'	1.21417966	o
o.906	1.4857877	1.54112703	-o.00012	2'	1.21417966	o
o.932	1.4857893	1.54115489	-o.00009	2'	1.21417966	o
o.957	1.4857904	1.54117599	-o.00007	2'	1.21417966	o
o.983	1.4857914	1.54119276	-o.00005	2'	1.21417966	o
1.008	1.4857921	1.54120598	-o.00004	2'	1.21417966	o

OMEGA 30000000 KAPPA 10.0000 DELTA 0.100000 VECTORLENGTH 0.40
REFLECTIONFACTOR 0.3585915 3.1415928 TRANSITFACTOR 1.3586138 0.0000000
ALPHA -0.00189 BETA -0.00528 GAMMA -0.00717

HEIGTH	THETA	E KELLER	ZETA		DISTORTION FUNCTION			
-1.000	1.2217305	1.00000000	-0.00005	2'	1.00000000	0	0.35859154	3.14159282
-0.932	1.2217360	1.00001629	-0.00009	2'	1.00000000	0	0.35859154	3.14159282
-0.863	1.2217471	1.00004860	-0.00018	3'	1.00000000	0	0.35859154	3.14159282
-0.795	1.2217689	1.00011263	-0.00035	3'	1.00000000	0	0.35859154	3.14159282
-0.726	1.2218122	1.00023952	-0.00070	3'	1.00000001	0	0.35859154	3.14159282
-0.658	1.2218979	1.00049078	-0.00139	3'	1.00000001	0	0.35859154	3.14159282
-0.590	1.2220674	1.00098810	-0.00275	4'	1.00000003	0	0.35859155	3.14159282
-0.521	1.2224021	1.00197116	-0.00545	4'	1.00000005	0	0.35859155	3.14159282
-0.453	1.2230600	1.00390942	-0.01078	4'	1.00000011	0	0.35859158	3.14159282
-0.385	1.2243436	1.00771197	-0.02131	5'	1.00000021	0	0.35859161	3.14159282
-0.317	1.2268108	1.01509959	-0.04203	6'	1.00000042	0	0.35859169	3.14159282
-0.250	1.2314211	1.02918829	-0.08250	8'	1.00000081	0	0.35859183	3.14159282
-0.183	1.2396050	1.05515201	-0.16054	10'	1.00000154	0.00000001	0.35859209	3.14159282
-0.118	1.2529264	1.10024006	-0.30763	16'	1.00000287	0.00000002	0.35859256	3.14159284
-0.055	1.2719592	1.17155771	-0.57477	33'	1.00000507	0.00000004	0.35859335	3.14159285
0.004	1.2949883	1.27088415	-0.96557	316'	1.35862323	0.00000007		
0.058	1.3184428	1.39052815	-0.56007	32'	1.35860706	0.00000006		
0.108	1.3391415	1.51610502	-0.33992	17'	1.35860953	0.00000005		
0.154	1.3557091	1.63393930	-0.21476	12'	1.35861102	0.00000004		
0.197	1.3682330	1.73574659	-0.14014	10'	1.35861196	0.00000004		
0.237	1.3774165	1.81874615	-0.09372	8'	1.35861255	0.00000004		
0.275	1.3840484	1.88374288	-0.06381	7'	1.35861294	0.00000004		
0.312	1.3888024	1.93323963	-0.04402	6'	1.35861321	0.00000004		
0.349	1.3921982	1.97020526	-0.03065	6'	1.35861338	0.00000004		
0.384	1.3946202	1.99743748	-0.02148	5'	1.35861351	0.00000004		
0.419	1.3963464	2.01730724	-0.01513	5'	1.35861360	0.00000004		
0.454	1.3975765	2.03170647	-0.01069	4'	1.35861366	0.00000004		
0.488	1.3984529	2.04209121	-0.00758	4'	1.35861370	0.00000004		
0.523	1.3990774	2.04955506	-0.00538	4'	1.35861373	0.00000004		
0.557	1.3995223	2.05490670	-0.00382	4'	1.35861374	0.00000004		
0.591	1.3998394	2.05873696	-0.00272	4'	1.35861376	0.00000004		
0.625	1.4000654	2.06147515	-0.00193	3'	1.35861377	0.00000004		
0.659	1.4002264	2.06343097	-0.00138	3'	1.35861379	0.00000004		
0.693	1.4003411	2.06482697	-0.00098	3'	1.35861379	0.00000004		
0.727	1.4004229	2.06582303	-0.00070	3'	1.35861379	0.00000004		
0.761	1.4004812	2.06653342	-0.00050	3'	1.35861380	0.00000004		
0.795	1.4005227	2.06704004	-0.00035	3'	1.35861380	0.00000004		
0.828	1.4005523	2.06740109	-0.00025	3'	1.35861380	0.00000004		
0.862	1.4005734	2.06765876	-0.00018	3'	1.35861380	0.00000004		
0.896	1.4005885	2.06784227	-0.00013	3'	1.35861380	0.00000004		
0.930	1.4005992	2.06797317	-0.00009	2'	1.35861380	0.00000004		
0.964	1.4006068	2.06806638	-0.00007	2'	1.35861380	0.00000004		
0.998	1.4006123	2.06813285	-0.00005	2'	1.35861380	0.00000004		
1.032	1.4006161	2.06818017	-0.00003	2'	1.35861380	0.00000004		

OMEGA 3.0000$_{10}$+07 KAPPA 0.001 DELTA 0.00001

THETA	ALPHA	BETA	GAMMA	REFLECTIONFACTOR		TRANSITFACTOR	
0	0.00050	200.00050	200.00100	0	3.147460938	1.00000000	6.283181489
0.1745329	0.00051	196.96203	196.96254	0	3.147542953	1.00000191	0
0.3490658	0.00053	187.93893	187.93946	0	3.147783279	1.00000381	0
0.5235988	0.00058	173.20537	173.20595	0	3.148216218	1.00000381	0
0.6981317	0.00065	153.20900	153.20965	0	3.148916245	1.00000286	6.283181489
0.8726646	0.00078	128.55739	128.55817	0	3.150048256	1.00000572	0.000001907
1.0471976	0.00100	99.99950	100.00050	0	3.151959419	1.00000954	0.000001907
1.1344640	0.00118	84.52289	84.52407	0	3.153454781	1.00001431	6.283181489
1.2217305	0.00146	68.40291	68.40437	0	3.155637741	1.00002146	6.283184350
1.3089969	0.00193	51.76214	51.76407	0	3.159073353	1.00003672	0
1.3962634	0.00288	34.72693	34.72981	0	3.165348530	1.00008321	0
1.4835299	0.00574	17.42550	17.43124	0	3.181024432	1.00032931	0.000001907
TOTALREFLECTION							
1.5676343	0.31623	0.31623	0.63246	1.000000000	3.263062499	2.28839909	0.060734928

OMEGA 3.0000$_{10}$+07 KAPPA 0.001 DELTA 0.00010

THETA	ALPHA	BETA	GAMMA	REFLECTIONFACTOR		TRANSITFACTOR	
0	0.00500	200.00500	200.01000	0	3.200347900	1.00002180	0
0.1745329	0.00508	196.96632	196.97140	0	3.201089859	1.00002289	6.283177674
0.3490658	0.00532	187.94260	187.94792	0	3.203454971	1.00002670	6.283181489
0.5235988	0.00577	173.20797	173.21374	0	3.207773209	1.00003242	6.283181489
0.6981317	0.00653	153.21002	153.21655	0	3.214813232	1.00004101	6.283181489
0.8726646	0.00778	128.55617	128.56395	0	3.226126671	1.00006008	0
1.0471976	0.01000	99.99500	100.00500	0	3.245245934	1.00010109	0
1.1344640	0.01183	84.51605	84.52788	0	3.260247231	1.00014020	6.283183396
1.2217305	0.01462	68.39283	68.40745	0	3.282035828	1.00021365	0.000004768
1.3089969	0.01932	51.74707	51.76640	0	3.316430092	1.00037343	0.000007629
1.3962634	0.02882	34.70256	34.73138	0	3.379280567	1.00083075	0.000023365
1.4835299	0.05756	17.37447	17.43203	0	3.536749959	1.00331808	0.000190258
TOTALREFLECTION							
1.5607968	1.00000	1.00000	2.00000	1.000000000	4.607446149	3.55153247	0.732926756

OMEGA 3.0000$_{10}$+07 KAPPA 0.001 DELTA 0.00100

THETA	ALPHA	BETA	GAMMA	REFLECTIONFACTOR		TRANSITFACTOR	
0	0.04999	200.04999	200.09997	0	3.728923798	1.00024989	0.000011444
0.1745329	0.05076	197.00925	197.06001	0	3.736440659	1.00025561	0.000011444
0.3490658	0.05320	187.97927	188.03247	0	3.760017395	1.00028232	0.000011444
0.5235988	0.05773	173.23394	173.29166	0	3.803211212	1.00033575	0.000019073
0.6981317	0.06527	153.22021	153.28548	0	3.873559952	1.00042447	0.000026703
0.8726646	0.07779	128.54399	128.62179	0	3.986659050	1.00060577	0.000045776
1.0471976	0.10005	99.94994	100.04999	0	4.177790642	1.00100090	0.000097275
1.1344640	0.11842	84.44750	84.56591	0	4.327771187	1.00140288	0.000165939
1.2217305	0.14643	68.29180	68.43823	0	4.545447826	1.00214616	0.000313759
1.3089969	0.19381	51.59589	51.78970	0	4.888942242	1.00376359	0.000727654
1.3962634	0.29022	34.45680	34.74702	0	5.514903307	1.00845842	0.002443790
1.4835299	0.59360	16.84631	17.43992	0	0.774566991	1.03587946	0.020907998
TOTALREFLECTION							
1.5391848	3.16228	3.16228	6.32456	1.000000060	4.134703100	6.30383857	3.638147891

OMEGA 3.0000$_{10}$+07 KAPPA 0.001 DELTA 0.01000

THETA	ALPHA	BETA	GAMMA	REFLECTIONFACTOR		TRANSITFACTOR	

OMEGA 3000000 KAPPA 0.0100 DELTA 0.001000 VECTORLENGTH 0.40
ALPHA -0.13565 BETA -0.73719 GAMMA -0.87284
REFLECTIONFACTOR 0.0875228 3.2780971 TRANSITFACTOR 1.1999593 0.0159014

HEIGTH	THETA	E KELLER	ZETA		DISTORTION FUNCTION			
-1000.000	1.5271629	1.00000000	-0.00005	2°	1.00000258	0.00000225	0.08752299	3.27809931
-991.276	1.5271630	1.00000094	-0.00005	2°	1.00000281	0.00000245	0.08752301	3.27809952
-982.552	1.5271630	1.00000187	-0.00005	2°	1.00000307	0.00000267	0.08752304	3.27809975
-973.828	1.5271631	1.00000290	-0.00006	2°	1.00000335	0.00000292	0.08752306	3.27809999
-965.104	1.5271631	1.00000487	-0.00006	2°	1.00000365	0.00000319	0.08752309	3.27810025
-956.381	1.5271632	1.00000580	-0.00007	2°	1.00000399	0.00000348	0.08752312	3.27810054
-947.657	1.5271633	1.00000777	-0.00008	2°	1.00000435	0.00000380	0.08752315	3.27810086
-938.933	1.5271634	1.00001076	-0.00008	2°	1.00000475	0.00000414	0.08752318	3.27810121
-930.209	1.5271635	1.00001272	-0.00009	2°	1.00000518	0.00000452	0.08752322	3.27810159
-921.485	1.5271636	1.00001460	-0.00010	2°	1.00000565	0.00000493	0.08752326	3.27810200
-912.761	1.5271637	1.00001759	-0.00011	2°	1.00000617	0.00000538	0.08752331	3.27810245
-904.038	1.5271638	1.00001955	-0.00012	2°	1.00000673	0.00000587	0.08752336	3.27810293
-895.314	1.5271639	1.00002246	-0.00013	3°	1.00000734	0.00000641	0.08752341	3.27810347
-886.590	1.5271640	1.00002544	-0.00014	3°	1.00000801	0.00000699	0.08752347	3.27810406
-877.867	1.5271642	1.00002929	-0.00015	3°	1.00000874	0.00000763	0.08752353	3.27810469
-869.143	1.5271644	1.00003321	-0.00017	3°	1.00000953	0.00000832	0.08752360	3.27810539
-860.419	1.5271646	1.00003714	-0.00018	3°	1.00001041	0.00000908	0.08752368	3.27810615
-851.696	1.5271647	1.00004107	-0.00020	3°	1.00001135	0.00000991	0.08752376	3.27810698
-842.972	1.5271649	1.00004594	-0.00022	3°	1.00001239	0.00001081	0.08752385	3.27810788
-834.249	1.5271652	1.00005090	-0.00024	3°	1.00001352	0.00001180	0.08752395	3.27810887
-825.525	1.5271654	1.00005671	-0.00026	3°	1.00001475	0.00001287	0.08752406	3.27810994
-816.802	1.5271657	1.00006362	-0.00028	3°	1.00001610	0.00001404	0.08752418	3.27811112
-808.078	1.5271660	1.00007045	-0.00031	3°	1.00001756	0.00001533	0.08752431	3.27811240
-799.355	1.5271663	1.00007635	-0.00034	3°	1.00001916	0.00001673	0.08752445	3.27811379
-790.632	1.5271666	1.00008412	-0.00037	3°	1.00002091	0.00001825	0.08752460	3.27811532
-781.909	1.5271670	1.00009301	-0.00040	3°	1.00002281	0.00001992	0.08752477	3.27811698
-773.186	1.5271674	1.00010275	-0.00044	3°	1.00002489	0.00002173	0.08752495	3.27811880
-764.463	1.5271679	1.00011351	-0.00048	3°	1.00002716	0.00002371	0.08752515	3.27812077
-755.740	1.5271684	1.00012530	-0.00052	3°	1.00002963	0.00002587	0.08752536	3.27812294
-747.017	1.5271689	1.00013700	-0.00057	3°	1.00003234	0.00002823	0.08752560	3.27812529
-738.294	1.5271695	1.00015075	-0.00062	3°	1.00003528	0.00003080	0.08752586	3.27812786
-729.572	1.5271702	1.00016639	-0.00068	3°	1.00003850	0.00003360	0.08752614	3.27813067
-720.849	1.5271709	1.00018211	-0.00074	3°	1.00004201	0.00003667	0.08752645	3.27813374
-712.127	1.5271716	1.00019971	-0.00081	3°	1.00004583	0.00004001	0.08752678	3.27813707
-703.405	1.5271725	1.00021927	-0.00088	3°	1.00005001	0.00004365	0.08752715	3.27814072
-694.683	1.5271734	1.00023986	-0.00096	3°	1.00005456	0.00004763	0.08752754	3.27814470
-677.239	1.5271755	1.00028891	-0.00114	3°	1.00006496	0.00005671	0.08752845	3.27815378
-659.796	1.5271780	1.00034574	-0.00136	3°	1.00007733	0.00006751	0.08752954	3.27816458
-642.354	1.5271809	1.00041232	-0.00162	3°	1.00009206	0.00008037	0.08753083	3.27817744
-624.914	1.5271845	1.00049370	-0.00193	3°	1.00010959	0.00009568	0.08753236	3.27819274
-607.475	1.5271887	1.00059082	-0.00230	3°	1.00013045	0.00011390	0.08753419	3.27821097
-590.037	1.5271937	1.00070599	-0.00274	4°	1.00015528	0.00013559	0.08753636	3.27823266
-572.601	1.5271996	1.00084193	-0.00326	4°	1.00018483	0.00016139	0.08753895	3.27825847
-555.168	1.5272066	1.00100296	-0.00388	4°	1.00021999	0.00019211	0.08754202	3.27828918
-537.738	1.5272151	1.00119640	-0.00462	4°	1.00026181	0.00022865	0.08754568	3.27832572
-520.311	1.5272251	1.00142640	-0.00550	4°	1.00031156	0.00027213	0.08755004	3.27836920
-502.888	1.5272369	1.00169789	-0.00655	4°	1.00037073	0.00032385	0.08755522	3.27842093
-485.470	1.5272510	1.00202278	-0.00779	4°	1.00044109	0.00038538	0.08756137	3.27848244
-468.057	1.5272677	1.00240708	-0.00927	4°	1.00052473	0.00045854	0.08756869	3.27855560
-450.651	1.5272875	1.00286391	-0.01104	4°	1.00062414	0.00054552	0.08757739	3.27864258
-433.253	1.5273110	1.00340646	-0.01313	5°	1.00074222	0.00064889	0.08758773	3.27874596
-415.864	1.5273388	1.00404789	-0.01563	5°	1.00088245	0.00077173	0.08760000	3.27886880
-398.487	1.5273718	1.00481078	-0.01859	5°	1.00104890	0.00091764	0.08761457	3.27901470
-381.123	1.5274107	1.00571283	-0.02212	5°	1.00124635	0.00109085	0.08763185	3.27918791
-363.774	1.5274567	1.00678001	-0.02631	5°	1.00148041	0.00129637	0.08765234	3.27939344
-346.443	1.5275109	1.00804216	-0.03129	6°	1.00175766	0.00154009	0.08767660	3.27963716
-329.135	1.5275747	1.00953051	-0.03720	6°	1.00208576	0.00182889	0.08770532	3.27992995

-311.851	1.5276497	1.01128459	-0.04422	6'	1.00247358	0.00217079	0.08773926	3.28026786
-294.998	1.5277374	1.01334621	-0.05255	7'	1.00293143	0.00257517	0.08777934	3.28067224
-277.380	1.5278399	1.01576392	-0.06242	7'	1.00347111	0.00305287	0.08782657	3.28114994
-260.202	1.5279592	1.01859407	-0.07412	7'	1.00410615	0.00361639	0.08788215	3.28171346
-243.073	1.5280976	1.02189582	-0.08797	8'	1.00485184	0.00428008	0.08794742	3.28237715
-225.999	1.5282572	1.02573238	-0.10435	8'	1.00572544	0.00506032	0.08802388	3.28315739
-208.988	1.5284406	1.03017486	-0.12370	9'	1.00674610	0.00597560	0.08811321	3.28407267
-192.051	1.5286500	1.03529532	-0.14653	10'	1.00793491	0.00704669	0.08821725	3.28514377
-175.197	1.5288876	1.04116493	-0.17343	11'	1.00931474	0.00829666	0.08833802	3.28639374
-158.439	1.5291550	1.04785342	-0.20507	12'	1.01091001	0.00975086	0.08847764	3.28784794
-141.787	1.5294537	1.05542532	-0.24223	13'	1.01274630	0.01143678	0.08863836	3.28953387
-125.255	1.5297843	1.06393617	-0.28578	15'	1.01484987	0.01338390	0.08882247	3.29148097
-108.854	1.5301467	1.07342413	-0.33671	17'	1.01724693	0.01562322	0.08903227	3.29372030
-92.599	1.5305398	1.08390875	-0.39614	20'	1.01996293	0.01818694	0.08926998	3.29628403
-76.501	1.5309616	1.09538907	-0.46533	24'	1.02302168	0.02110784	0.08953769	3.29920493
-60.571	1.5314089	1.10783232	-0.54569	30'	1.02644444	0.02441861	0.08983726	3.30251571
-44.820	1.5318777	1.12117929	-0.63878	40'	1.03024909	0.02815126	0.09017025	3.30624836
-29.257	1.5323630	1.13534105	-0.74635	62'	1.03444943	0.03233640	0.09053788	3.31043351
-13.887	1.5328596	1.15020643	-0.87034	129'	1.03905455	0.03700266	0.09094093	3.31509977
1.284	1.5333616	1.16563408	-0.98724	316'	1.15690453	0.05360435		
16.254	1.5338631	1.18146676	-0.84998	112'	1.14099982	0.05036689		
31.024	1.5343588	1.19754193	-0.73327	59'	1.14764880	0.04594641		
45.596	1.5348434	1.21368886	-0.63384	40'	1.15360425	0.04211143		
59.974	1.5353126	1.22973817	-0.54895	31'	1.15891996	0.03878449		
74.165	1.5357626	1.24553822	-0.47633	25'	1.16365126	0.03589748		
88.175	1.5361906	1.26094734	-0.41406	21'	1.16785280	0.03339089		
102.015	1.5365946	1.27584386	-0.36054	18'	1.17157720	0.03121299		
115.693	1.5369732	1.29012787	-0.31445	16'	1.17487413	0.02931896		
129.220	1.5373258	1.30372318	-0.27467	15'	1.17778972	0.02767014		
142.605	1.5376524	1.31657231	-0.24026	13'	1.18036621	0.02623320		
155.860	1.5379533	1.32863692	-0.21043	12'	1.18264200	0.02497949		
168.995	1.5382294	1.33990303	-0.18453	11'	1.18465161	0.02388440		
182.020	1.5384816	1.35036054	-0.16199	10'	1.18642596	0.02292677		
194.943	1.5387112	1.36002664	-0.14235	10'	1.18799259	0.02208840		
207.775	1.5389197	1.36892073	-0.12521	9'	1.18937594	0.02135366		
220.524	1.5391083	1.37707075	-0.11022	9'	1.19059764	0.02070909		
233.197	1.5392787	1.38451559	-0.09710	8'	1.19167677	0.02014307		
245.802	1.5394322	1.39129370	-0.08560	8'	1.19263018	0.01964558		
258.345	1.5395702	1.39744267	-0.07551	8'	1.19347271	0.01920796		
270.834	1.5396941	1.40301146	-0.06665	7'	1.19421744	0.01882271		
283.273	1.5398052	1.40804325	-0.05885	7'	1.19487590	0.01848331		
295.667	1.5399047	1.41257760	-0.05199	7'	1.19545819	0.01818413		
308.022	1.5399937	1.41666042	-0.04595	6'	1.19597327	0.01792023		
320.341	1.5400732	1.42032738	-0.04062	6'	1.19642895	0.01768733		
332.628	1.5401442	1.42361628	-0.03593	6'	1.19683221	0.01748168		
344.887	1.5402075	1.42656431	-0.03178	6'	1.19718911	0.01730003		
357.121	1.5402639	1.42919924	-0.02812	6'	1.19750506	0.01713951		
369.332	1.5403142	1.43155602	-0.02489	5'	1.19778479	0.01699760		
381.523	1.5403589	1.43366203	-0.02203	5'	1.19803249	0.01687211		
393.696	1.5403987	1.43553983	-0.01951	5'	1.19825186	0.01676110		
405.853	1.5404342	1.43721583	-0.01727	5'	1.19844617	0.01666289		
417.996	1.5404657	1.43870838	-0.01530	5'	1.19861828	0.01657597		
430.126	1.5404937	1.44003900	-0.01355	5'	1.19877076	0.01649904		
442.246	1.5405185	1.44122095	-0.01200	5'	1.19890586	0.01643091		
454.355	1.5405406	1.44227359	-0.01064	4'	1.19902557	0.01637060		
466.455	1.5405603	1.44321109	-0.00942	4'	1.19913164	0.01631719		
478.548	1.5405777	1.44404405	-0.00835	4'	1.19922564	0.01626988		
490.634	1.5405932	1.44478420	-0.00740	4'	1.19930894	0.01622797		
502.713	1.5406070	1.44544270	-0.00656	4'	1.19938277	0.01619083		
514.787	1.5406191	1.44602521	-0.00581	4'	1.19944821	0.01615794		
526.856	1.5406299	1.44654332	-0.00515	4'	1.19950622	0.01612879		
538.921	1.5406396	1.44700853	-0.00457	4'	1.19955762	0.01610296		
550.982	1.5406481	1.44741483	-0.00405	4'	1.19960319	0.01608007		

563.039	1.5406557	1.44777983	-0.00359	4'	1.19964399	0.01605979
575.093	1.5406624	1.44810061	-0.00318	4'	1.19967940	0.01604181
587.145	1.5406683	1.44838607	-0.00282	4'	1.19971116	0.01602587
599.195	1.5406736	1.44864171	-0.00250	4'	1.19973930	0.01601174
611.242	1.5406783	1.44886787	-0.00222	3'	1.19976424	0.01599923
623.287	1.5406825	1.44906739	-0.00196	3'	1.19978636	0.01598813
635.331	1.5406861	1.44924294	-0.00174	3'	1.19980597	0.01597829
647.373	1.5406894	1.44940094	-0.00154	3'	1.19982336	0.01596957
659.414	1.5406923	1.44954087	-0.00137	3'	1.19983876	0.01596184
671.454	1.5406949	1.44966611	-0.00121	3'	1.19985244	0.01595499
683.493	1.5406972	1.44977646	-0.00108	3'	1.19986455	0.01594891
695.531	1.5406992	1.44987176	-0.00095	3'	1.19987529	0.01594352
707.568	1.5407010	1.44995828	-0.00085	3'	1.19988481	0.01593874
719.604	1.5407026	1.45003583	-0.00075	3'	1.19989325	0.01593451
731.640	1.5407040	1.45010459	-0.00066	3'	1.19990074	0.01593076
743.675	1.5407052	1.45016420	-0.00059	3'	1.19990738	0.01592743
755.709	1.5407063	1.4502[illegible]789	-0.00052	3'	1.19991326	0.01592448
767.744	1.5407073	1.45026566	-0.00046	3'	1.19991848	0.01592186
779.777	1.5407082	1.45030750	-0.00041	3'	1.19992310	0.01591954
791.811	1.5407089	1.45034324	-0.00036	3'	1.19992720	0.01591749
803.844	1.5407096	1.45037611	-0.00032	3'	1.19993084	0.01591566
815.877	1.5407102	1.45040593	-0.00029	3'	1.19993406	0.01591405
827.909	1.5407108	1.45043287	-0.00025	3'	1.19993692	0.01591261
839.942	1.5407113	1.45045676	-0.00022	3'	1.19993946	0.01591134
851.974	1.5407117	1.45047455	-0.00020	3'	1.19994171	0.01591022
864.006	1.5407121	1.45049556	-0.00018	3'	1.19994370	0.01590922
876.038	1.5407124	1.45051047	-0.00016	3'	1.19994546	0.01590833
888.070	1.5407127	1.45052538	-0.00014	3'	1.19994703	0.01590755
900.101	1.5407130	1.45053742	-0.00012	3'	1.19994842	0.01590685
912.133	1.5407132	1.45054928	-0.00011	2'	1.19994965	0.01590624
924.164	1.5407134	1.45055826	-0.00010	2'	1.19995074	0.01590569
936.196	1.5407136	1.45056724	-0.00009	2'	1.19995171	0.01590520
948.227	1.5407138	1.45057622	-0.00008	2'	1.19995257	0.01590477
960.258	1.5407139	1.45058215	-0.00007	2'	1.19995333	0.01590439
972.289	1.5407140	1.45058808	-0.00006	2'	1.19995400	0.01590405
984.320	1.5407141	1.45059401	-0.00005	2'	1.19995460	0.01590375
996.351	1.5407142	1.45059706	-0.00005	2'	1.19995513	0.01590349
1008.382	1.5407143	1.45060300	-0.00004	2'	1.19995560	0.01590325

OMEGA 3.0000000 KAPPA 0.0100 DELTA 0.001000 VECTORLENGTH 0.40
ALPHA -1.35651 BETA -7.37185 GAMMA -8.72836
REFLECTIONFACTOR 0.0000000 2.9578171 TRANSITFACTOR 1.2045816 0.2502477

HEIGTH	THETA	E KELLER	ZETA		DISTORTION FUNCTION			
-1000.000	1.5271629	1.00000000	-0.00005	2'	1.00000588	0.00005134	0.0000001	2.95784844
-982.552	1.5271630	1.00000187	-0.00005	2'	1.00000700	0.00006112	0.0000001	2.95787822
-965.104	1.5271631	1.00000487	-0.00006	2'	1.00000833	0.00007278	0.0000001	2.95788988
-947.657	1.5271633	1.00000777	-0.00008	2'	1.00000993	0.00008665	0.0000001	2.95790375
-930.209	1.5271635	1.00001272	-0.00009	2'	1.00001182	0.00010317	0.0000001	2.95792027
-912.761	1.5271637	1.00001799	-0.00011	2'	1.00001407	0.00012283	0.0000001	2.95793993
-895.314	1.5271639	1.00002246	-0.00013	2'	1.00001676	0.00014625	0.0000001	2.95796335
-877.866	1.5271642	1.00002929	-0.00015	2'	1.00001995	0.00017412	0.0000001	2.95799122
-860.419	1.5271646	1.00003714	-0.00018	2'	1.00002375	0.00020730	0.0000001	2.95802441
-842.972	1.5271649	1.00004594	-0.00022	2'	1.00002828	0.00024682	0.0000001	2.95806392
-825.525	1.5271654	1.00005671	-0.00026	2'	1.00003367	0.00029387	0.0000001	2.95811097
-808.078	1.5271660	1.00007045	-0.00031	2'	1.00004008	0.00034987	0.0000001	2.95816697
-790.632	1.5271666	1.00008412	-0.00037	3'	1.00004772	0.00041655	0.0000001	2.95823365
-773.185	1.5271674	1.00010275	-0.00044	3'	1.00005681	0.00049593	0.0000001	2.95831303
-755.739	1.5271684	1.00012530	-0.00052	3'	1.00006764	0.00059044	0.0000001	2.95840754
-738.294	1.5271695	1.00015075	-0.00062	3'	1.00008052	0.00070295	0.0000001	2.95852005
-720.848	1.5271709	1.00018211	-0.00074	3'	1.00009586	0.00083688	0.0000001	2.95865398
-703.404	1.5271725	1.00021927	-0.00088	3'	1.00011412	0.00099632	0.0000001	2.95881342
-685.960	1.5271744	1.00026336	-0.00105	3'	1.00013586	0.00118611	0.0000001	2.95900321
-668.516	1.5271767	1.00031532	-0.00125	3'	1.00016173	0.00141203	0.0000001	2.95922913
-651.074	1.5271794	1.00037805	-0.00149	3'	1.00019252	0.00168093	0.0000001	2.95949804
-633.633	1.5271826	1.00045156	-0.00177	3'	1.00022915	0.00200099	0.0000001	2.95981809
-616.193	1.5271865	1.00054081	-0.00211	3'	1.00027276	0.00238190	0.0000001	2.96019901
-598.755	1.5271911	1.00064573	-0.00251	3'	1.00032464	0.00283520	0.0000001	2.96065231
-581.318	1.5271965	1.00077034	-0.00299	3'	1.00038636	0.00337460	0.0000001	2.96119171
-563.884	1.5272030	1.00091851	-0.00356	4'	1.00045978	0.00401638	0.0000001	2.96183348
-546.452	1.5272107	1.00109522	-0.00423	4'	1.00054710	0.00477986	0.0000001	2.96259697
-529.023	1.5272199	1.00130650	-0.00504	4'	1.00065092	0.00568800	0.0000001	2.96350511
-511.598	1.5272308	1.00155719	-0.00600	4'	1.00077434	0.00676800	0.0000001	2.96458510
-494.177	1.5272436	1.00185336	-0.00714	4'	1.00092101	0.00805208	0.0000001	2.96586919
-476.762	1.5272589	1.00220597	-0.00850	4'	1.00109525	0.00957843	0.0000001	2.96739554
-459.352	1.5272771	1.00262510	-0.01012	4'	1.00130218	0.01139218	0.0000001	2.96920930
-441.950	1.5272987	1.00312269	-0.01204	4'	1.00154776	0.01354667	0.0000001	2.97136379
-424.556	1.5273243	1.00371318	-0.01433	5'	1.00183908	0.01610478	0.0000001	2.97392190
-407.173	1.5273546	1.00441376	-0.01705	5'	1.00218440	0.01914056	0.0000001	2.97695769
-389.802	1.5273904	1.00524313	-0.02028	5'	1.00259340	0.02274101	0.0000001	2.98055814
-372.445	1.5274327	1.00622404	-0.02413	5'	1.00307735	0.02700807	0.0000001	2.98482521
-355.105	1.5274827	1.00738494	-0.02869	6'	1.00364932	0.03206088	0.0000001	2.98987802
-337.785	1.5275415	1.00875584	-0.03412	6'	1.00432440	0.03803813	0.0000001	2.99585527
-320.488	1.5276107	1.01037156	-0.04056	6'	1.00511992	0.04510063	0.0000001	3.00291779
-303.220	1.5276918	1.01227418	-0.04821	6'	1.00605562	0.05343395	0.0000001	3.01125112
-285.983	1.5277867	1.01450743	-0.05728	7'	1.00715379	0.06325095	0.0000001	3.02106812
-268.785	1.5278973	1.01712406	-0.06803	7'	1.00843936	0.07479412	0.0000001	3.03261130
-251.630	1.5280258	1.02018164	-0.08076	8'	1.00993986	0.08833753	0.0000001	3.04615471
-234.527	1.5281746	1.02374288	-0.09582	8'	1.01168522	0.10418794	0.0000001	3.06200511
-217.484	1.5283458	1.02787410	-0.11363	9'	1.01370740	0.12268492	0.0000001	3.08050209
-200.509	1.5285420	1.03264637	-0.13465	9'	1.01603971	0.14419945	0.0000001	3.10201660
-183.612	1.5287651	1.03813117	-0.15944	10'	1.01871590	0.16913061	0.0000001	3.12694772
-166.804	1.5290174	1.04440163	-0.18862	11'	1.02176883	0.19789992	0.0000001	3.15571701
-150.098	1.5293004	1.05152616	-0.22291	12'	1.02522884	0.23094317	0.0000001	3.18876021
-133.504	1.5296150	1.05956130	-0.26315	14'	1.02912184	0.26869936	0.0000001	3.22651640
-117.036	1.5299616	1.06855661	-0.31025	16'	1.03346709	0.31159756	0.0000001	3.26941462
-100.707	1.5303396	1.07854287	-0.36529	18'	1.03827504	0.36004125	0.0000001	3.31785838
-84.529	1.5307473	1.08952764	-0.42943	21'	1.04354516	0.41439202	0.0000001	3.37220920
-68.513	1.5311823	1.10149257	-0.50402	26'	1.04926433	0.47495339	0.0000001	3.43277053
-52.672	1.5316409	1.11439772	-0.59054	33'	1.05540576	0.54195631	0.0000001	3.49977337
-37.014	1.5321186	1.12816613	-0.69064	47'	1.06192873	0.61554752	0.0000001	3.57336463

-21.546	1.5326103	1.14269542	-0.80617	83'	1.06877953	0.69578347	0.0000001	3.65360057
-6.276	1.5331103	1.15785995	-0.93917	3 283'	1.07589310	0.78262760	0.0000001	3.74044468
8.795	1.5336128	1.17351150	-0.91580	3 247'	1.08319557	1.25714102		
23.665	1.5341121	1.18948708	-0.78927	92'	1.09060830	1.15503161		
38.336	1.5346028	1.20561670	-0.68157	57'	1.09804998	1.06163098		
52.810	1.5350802	1.22173443	-0.59973	41'	1.10544146	0.97656351		
67.093	1.5355402	1.23768039	-0.51123	32'	1.11270832	0.89938839		
81.193	1.5359795	1.25330085	-0.44400	26'	1.11978368	0.82961917		
95.117	1.5363957	1.26846991	-0.38629	22'	1.12661004	0.76674083		
108.874	1.5367872	1.28306883	-0.33664	19'	1.13314036	0.71022682		
122.475	1.5371529	1.29701831	-0.29383	17'	1.13933849	0.65955234		
135.930	1.5374924	1.31024465	-0.25684	16'	1.14517896	0.61420545		
149.249	1.5378061	1.32270483	-0.22481	14'	1.15064628	0.57369514		
162.443	1.5380944	1.33437017	-0.19702	13'	1.15573378	0.53755723		
175.521	1.5383584	1.34523113	-0.17287	12'	1.16044260	0.50535811		
188.494	1.5385991	1.35529076	-0.15184	11'	1.16477933	0.47669663		
201.371	1.5388180	1.36456881	-0.13349	10'	1.16875663	0.45120463		
214.160	1.5390164	1.37308650	-0.11747	10'	1.17239009	0.42854650		
226.870	1.5391957	1.38088115	-0.10345	9'	1.17569803	0.40841783		
239.508	1.5393575	1.38798774	-0.09117	9'	1.17870046	0.39054389		
252.082	1.5395030	1.39444293	-0.08039	8'	1.18141823	0.37467748		
264.597	1.5396338	1.40029795	-0.07094	8'	1.18387247	0.36059690		
277.060	1.5397512	1.40559395	-0.06262	8'	1.18608401	0.34810384		
289.476	1.5398564	1.41037080	-0.05531	7'	1.18807315	0.33702119		
301.850	1.5399505	1.41467562	-0.04887	7'	1.18985928	0.32719099		
314.186	1.5400345	1.41854205	-0.04320	7'	1.19146079	0.31847260		
326.489	1.5401097	1.42201827	-0.03820	6'	1.19289490	0.31074088		
338.762	1.5401767	1.42512909	-0.03379	6'	1.19417764	0.30388460		
351.008	1.5402365	1.42791852	-0.02989	6'	1.19532383	0.29780489		
363.230	1.5402897	1.43040924	-0.02646	6'	1.19634711	0.29241400		
375.430	1.5403372	1.43263944	-0.02342	6'	1.19725991	0.28763401		
387.612	1.5403794	1.43462896	-0.02073	5'	1.19807362	0.28339577		
399.777	1.5404169	1.43640042	-0.01836	5'	1.19879852	0.27963793		
411.927	1.5404504	1.43798343	-0.01626	5'	1.19944398	0.27630606		
424.064	1.5404801	1.43939372	-0.01440	5'	1.20001840	0.27335192		
436.188	1.5405065	1.44064710	-0.01275	5'	1.20052941	0.27073268		
448.302	1.5405299	1.44176314	-0.01130	5'	1.20098382	0.26841038		
460.407	1.5405507	1.44275525	-0.01001	5'	1.20138777	0.26635136		
472.503	1.5405693	1.44364070	-0.00887	4'	1.20174676	0.26452579		
484.592	1.5405857	1.44442427	-0.00786	4'	1.20206570	0.26290717		
496.675	1.5406003	1.44512363	-0.00697	4'	1.20234900	0.26147207		
508.751	1.5406132	1.44574121	-0.00617	4'	1.20260059	0.26019966		
520.823	1.5406247	1.44629163	-0.00547	4'	1.20282398	0.25907150		
532.890	1.5406349	1.44678330	-0.00485	4'	1.20302230	0.25807124		
544.952	1.5406440	1.44721898	-0.00430	4'	1.20319833	0.25718437		
557.011	1.5406520	1.44760178	-0.00381	4'	1.20335456	0.25639804		
569.067	1.5406591	1.44794324	-0.00338	4'	1.20349320	0.25570086		
581.120	1.5406655	1.44824923	-0.00299	4'	1.20361623	0.25508271		
593.171	1.5406710	1.44851684	-0.00265	4'	1.20372538	0.25453464		
605.219	1.5406760	1.44875783	-0.00235	3'	1.20382222	0.25401870		
617.266	1.5406804	1.44896915	-0.00209	3'	1.20390813	0.25361784		
629.310	1.5406844	1.44915956	-0.00185	3'	1.20398434	0.25323582		
641.353	1.5406878	1.44932633	-0.00164	3'	1.20405194	0.25289711		
653.395	1.5406909	1.44947233	-0.00145	3'	1.20411189	0.25259680		
665.435	1.5406937	1.44960653	-0.00129	3'	1.20416507	0.25233053		
677.474	1.5406961	1.44972280	-0.00114	3'	1.20421224	0.25209444		
689.512	1.5406982	1.44982420	-0.00101	3'	1.20425407	0.25188512		
701.550	1.5407001	1.44991663	-0.00090	3'	1.20429117	0.25169951		
713.587	1.5407018	1.44999705	-0.00080	3'	1.20432406	0.25153495		
725.623	1.5407033	1.45007174	-0.00071	3'	1.20435325	0.25138905		
737.658	1.5407046	1.45013440	-0.00063	3'	1.20437912	0.25125968		
749.693	1.5407058	1.45019114	-0.00055	3'	1.20440206	0.25114498		
761.727	1.5407068	1.45024177	-0.00049	3'	1.20442240	0.25104328		

773.761	1.5407078	1.45028650	-0.00044	3°	1.20444044	0.25095311
785.795	1.5407086	1.45032528	-0.00039	3°	1.20445644	0.25087316
797.828	1.5407093	1.45036120	-0.00034	3°	1.20447063	0.25080227
809.861	1.5407099	1.45039102	-0.00030	3°	1.20448321	0.25073942
821.894	1.5407106	1.45042083	-0.00027	3°	1.20449436	0.25068369
833.926	1.5407111	1.45044473	-0.00024	3°	1.20450425	0.25063428
845.959	1.5407115	1.45046574	-0.00021	3°	1.20451302	0.25059047
857.991	1.5407119	1.45048699	-0.00019	2°	1.20452080	0.25055163
870.023	1.5407122	1.45050149	-0.00017	2°	1.20452769	0.25051718
882.055	1.5407125	1.45051640	-0.00015	2°	1.20453380	0.25048665
894.086	1.5407128	1.45053132	-0.00013	2°	1.20453922	0.25045957
906.118	1.5407131	1.45054335	-0.00012	2°	1.20454403	0.25043556
918.149	1.5407133	1.45055233	-0.00010	2°	1.20454829	0.25041428
930.181	1.5407135	1.45056418	-0.00009	2°	1.20455207	0.25039541
942.212	1.5407137	1.45057012	-0.00008	2°	1.20455541	0.25037868
954.243	1.5407138	1.45057910	-0.00007	2°	1.20455839	0.25036383
966.274	1.5407140	1.45058521	-0.00006	2°	1.20456102	0.25035068
978.306	1.5407141	1.45059114	-0.00006	2°	1.20456336	0.25033902
990.337	1.5407142	1.45059706	-0.00005	2°	1.20456542	0.25032867
1002.368	1.5407143	1.45060012	-0.00004	2°	1.20456726	0.25031950

OMEGA 2.00000000,+09 KAPPA 0.0100 DELTA 0.00100 VECTORLENGTH 1.60
ALPHA -13.96511 BETA -73.71853 GAMMA -87.28364
REFLECTIONFACTOR 0 1.9999427 TRANSITFACTOR 1.2045800 2.5103445

HEIGTH	THETA	E KELLER	ZETA		DISTORTION FUNCTION			
-1000.000	1.5271629	1.00000000	-0.00005	3°	1.00000596	0.00052007	•	•
-965.106	1.5271631	1.00000487	-0.00006	3°	1.00000845	0.00073723	•	•
-930.209	1.5271635	1.00001272	-0.00009	3°	1.00001197	0.00104507	•	•
-895.314	1.5271639	1.00002246	-0.00013	3°	1.00001697	0.00148145	•	•
-860.419	1.5271646	1.00003714	-0.00018	3°	1.00002406	0.00210002	•	•
-825.524	1.5271654	1.00005671	-0.00026	3°	1.00003410	0.00297683	•	•
-790.631	1.5271666	1.00008412	-0.00037	4°	1.00004834	0.00421963	•	•
-755.738	1.5271684	1.00012530	-0.00052	4°	1.00006852	0.00598112	•	•
-720.847	1.5271709	1.00018211	-0.00074	4°	1.00009711	0.00847758	•	•
-685.958	1.5271744	1.00026336	-0.00105	4°	1.00013762	0.01201534	•	•
-651.071	1.5271794	1.00037805	-0.00149	4°	1.00019502	0.01702800	•	•
-616.189	1.5271865	1.00054081	-0.00211	5°	1.00027630	0.02412900	•	•
-581.312	1.5271965	1.00077034	-0.00299	5°	1.00039138	0.03418548	•	•
-546.443	1.5272107	1.00109625	-0.00423	5°	1.00055420	0.04842175	•	•
-511.586	1.5272308	1.00155719	-0.00600	6°	1.00078441	0.06856345	•	•
-476.744	1.5272590	1.00220700	-0.00850	6°	1.00110951	0.09703714	•	•
-441.925	1.5272988	1.00312372	-0.01204	6°	1.00156792	0.13724349	•	•
-407.138	1.5273547	1.00441575	-0.01705	6°	1.00221286	0.19392572	•	•
-372.396	1.5274329	1.00622706	-0.02414	8°	1.00311748	0.27365529	•	•
-337.716	1.5275418	1.00876088	-0.03414	9°	1.00438086	0.38545153	•	•
-303.123	1.5276923	1.01228434	-0.04826	9°	1.00613476	0.54153034	•	•
-268.651	1.5278983	1.01714667	-0.06812	12°	1.00854975	0.75813260	•	•
-234.343	1.5281763	1.02378454	-0.09600	13°	1.01183803	1.05630068	•	•
-200.257	1.5285450	1.03272177	-0.13499	17°	1.01624887	1.46233784	•	•
-166.466	1.5290229	1.04453775	-0.18926	19°	1.02205047	2.00753181	•	•
-133.057	1.5296240	1.05979193	-0.26433	23°	1.02949231	2.72662643	•	•
-100.128	1.5303535	1.07891512	-0.36741	30°	1.03874689	3.65464868	•	•
-67.783	1.5312028	1.10206470	-0.50772	47°	1.04984011	4.82220562	•	•
-36.116	1.5321466	1.12898351	-0.69687	75°	1.06259914	6.25023168	•	•
-5.204	1.5331458	1.15895235	-0.94929	348°	1.07646113	1.66332509	•	•
24.909	1.5341539	1.19084338	-0.77951	224°	1.10526517	5.20931208		
54.216	1.5351261	1.22330800	-0.58149	95°	1.10617671	3.47906041		
82.747	1.5360269	1.25500738	-0.43716	56°	1.12037670	2.01365896		
110.557	1.5368336	1.28482217	-0.33102	42°	1.13361513	0.82329281		
137.722	1.5375360	1.31196065	-0.25228	30°	1.14553176	6.14904631		
164.325	1.5381338	1.33597744	-0.19335	24°	1.15597611	5.38447697		
190.450	1.5386337	1.35674731	-0.14890	21°	1.16493199	4.77701522		
216.176	1.5390459	1.37436510	-0.11512	18°	1.17247604	4.29606307		
241.572	1.5393823	1.38908529	-0.08930	16°	1.17874043	3.91617342		
266.699	1.5396545	1.40122594	-0.06946	13°	1.18388298	3.61658548		
291.609	1.5398733	1.41114953	-0.05415	12°	1.18806630	3.38057219		
316.363	1.5400484	1.41917942	-0.04228	11°	1.19144482	3.19477168		
340.938	1.5401878	1.42564761	-0.03306	9°	1.19415783	3.04856755		
365.420	1.5402987	1.43083039	-0.02588	9°	1.19632661	2.93355588		
389.815	1.5403865	1.43496135	-0.02028	9°	1.19805418	2.84310016		
414.139	1.5404560	1.43825114	-0.01590	8°	1.19942645	2.77196687		
438.407	1.5405110	1.44086368	-0.01247	6°	1.20051406	2.71603370		
462.632	1.5405543	1.44292571	-0.00979	6°	1.20137459	2.67205538		
486.822	1.5405885	1.44456003	-0.00769	6°	1.20205452	2.63747806		
510.985	1.5406154	1.44584776	-0.00604	6°	1.20259115	2.61029308		
535.126	1.5406367	1.44686624	-0.00474	6°	1.20301434	2.58892043		
559.250	1.5406534	1.44766995	-0.00373	6°	1.20334785	2.57211769		
583.360	1.5406665	1.44829974	-0.00293	5°	1.20361054	2.55890708		
607.461	1.5406769	1.44879941	-0.00230	5°	1.20381737	2.54852276		
631.552	1.5406851	1.44919237	-0.00181	5°	1.20398016	2.54035841		
655.638	1.5406914	1.44949924	-0.00142	5°	1.20410825	2.53392995		
679.718	1.5406965	1.44974362	-0.00112	5°	1.20420903	2.52889404		

703.794	1.5407005	1.44993440	-0.00088	4°	1.20428830	2.52492720
727.867	1.5407036	1.45008358	-0.00069	4°	1.20435064	2.52180866
751.938	1.5407060	1.45019993	-0.00054	4°	1.20439968	2.51935703
776.007	1.5407080	1.45029547	-0.00043	4°	1.20443823	2.51742967
800.074	1.5407094	1.45036713	-0.00034	4°	1.20446855	2.51591449
824.140	1.5407106	1.45042389	-0.00026	4°	1.20449238	2.51472333
848.204	1.5407115	1.45046862	-0.00021	3°	1.20451113	2.51378691
872.269	1.5407123	1.45050455	-0.00016	3°	1.20452587	2.51305074
896.332	1.5407129	1.45053436	-0.00013	3°	1.20453745	2.51247201
920.395	1.5407133	1.45055521	-0.00010	3°	1.20454656	2.51201704
944.458	1.5407137	1.45057318	-0.00008	3°	1.20455372	2.51165937
968.521	1.5407140	1.45058521	-0.00006	3°	1.20455935	2.51137818
992.583	1.5407142	1.45059706	-0.00005	3°	1.20456377	2.51115714
1016.645	1.5407144	1.45060605	-0.00004	3°	1.20456725	2.51098336

OMEGA 3000000 KAPPA 0.0001 DELTA 0.001000 VECTORLENGTH 1.60
ALPHA -13.56511 BETA -73.71853 GAMMA -87.28364
REFLECTIONFACTOR 0 1.59594 03 TRANSITFACTOR 1.2045806 2.5103464

HEIGTH	THETA	E KELLER	ZETA		DISTORTION FUNCTION			
-1.00000000$_{10}$+05	1.5271629	1.00000000	-0.00005	3'	1.00000596	0.00052007	0	0
-9.30208726$_{10}$+04	1.5271635	1.00001272	-0.00009	3'	1.00001197	0.00104508	0	0
-8.60418336$_{10}$+04	1.5271646	1.00003714	-0.00018	3'	1.00002406	0.00210004	0	0
-7.90629654$_{10}$+04	1.5271666	1.00008412	-0.00037	4'	1.00004834	0.00421963	0	0
-7.20841242$_{10}$+04	1.5271709	1.00018211	-0.00074	4'	1.00009711	0.00847781	0	0
-6.51065664$_{10}$+04	1.5271794	1.00037805	-0.00149	5'	1.00019503	0.01702892	0	0
-5.81300737$_{10}$+04	1.5271965	1.00077034	-0.00299	5'	1.00039142	0.03418927	0	0
-5.11563132$_{10}$+04	1.5272308	1.00155719	-0.00600	6'	1.00078458	0.06857882	0	0
-4.41880264$_{10}$+04	1.5272988	1.00312467	-0.01205	6'	1.00156862	0.13730499	0	0
-3.72306178$_{10}$+04	1.5274331	1.00623304	-0.02416	8'	1.00312023	0.27389827	0	0
-3.02946811$_{10}$+04	1.5276932	1.01230674	-0.04834	9'	1.00614525	0.51246648	0	0
-2.34003203$_{10}$+04	1.5281795	1.02386117	-0.09632	13'	1.01187585	1.05975173	0	0
-1.65836925$_{10}$+04	1.5290329	1.04478995	-0.19045	20'	1.02217399	2.01928101	0	0
-9903.492	1.5303801	1.07962646	-0.37145	31'	1.03908914	3.68972840	0	0
-3438.664	1.5322009	1.13057140	-0.70902	80'	1.06334066	0.05383354	0	0
2735.073	1.5342357	1.19350992	-0.76071	205'	1.08890594	5.10332960		
8583.469	1.5361204	1.25839277	-0.42386	55'	1.12138911	1.87025003		
1.41305063$_{10}$+04	1.5376217	1.31535254	-0.24340	30'	1.14701387	6.03661096		
1.94374713$_{10}$+04	1.5387015	1.35961566	-0.14317	21'	1.16616438	4.69664434		
2.45717554$_{10}$+04	1.5394312	1.39124891	-0.08568	16'	1.17965360	3.86192968		
2.95893578$_{10}$+04	1.5399064	1.41265751	-0.05187	12'	1.18870400	3.34521205		
3.45309558$_{10}$+04	1.5402095	1.42665815	-0.03165	9'	1.19458169	3.02599340		
3.94240817$_{10}$+04	1.5404004	1.43561796	-0.01940	9'	1.19832834	2.82896976		
[illegible]	[illegible]	1.44127664	-0.01193					
4.91302027$_{10}$+04	1.5405940	1.44482252	-0.00735	6'	1.20216438	2.63193583		
5.39618403$_{10}$+04	1.5406401	1.44703212	-0.00453	6'	1.20308318	2.58548011		
[illegible]	[illegible]	1.44840380	-0.00280					
6.36057999$_{10}$+04	1.5406864	1.44925495	-0.00173	5'	1.20400708	2.53903950		
6.84226669$_{10}$+04	1.5406973	1.44978238	-0.00107	5'	1.20422593	2.52807877		
7.32377825$_{10}$+04	1.5407041	1.45010746	-0.00066	4'	1.20436132	2.52130519		
7.80518191$_{10}$+04	1.5407083	1.45031038	-0.00041	4'	1.20444506	2.51711911		
8.28651824$_{10}$+04	1.5407108	1.45043287	-0.00025	4'	1.20449682	2.51453208		
8.76781395$_{10}$+04	1.5407124	1.45051047	-0.00016	3'	1.20452883	2.51293325		
9.24908392$_{10}$+04	1.5407134	1.45055826	-0.00010	3'	1.20454861	2.51194515		
9.73033804$_{10}$+04	1.5407140	1.45058808	-0.00006	3'	1.20456084	2.51133449		
1.02115822$_{10}$+05	1.5407144	1.45060605	-0.00004	3'	1.20456839	2.51095708		

OMEGA 300000000 KAPPA 0.0010 DELTA 0.001000 VECTORLENGTH 1.60
ALPHA -13.56511 BETA -73.71853 GAMMA -87.28364
REFLECTIONFACTOR 0 1.5959427 TRANSITFACTOR 1.2045800 2.5103145

HEIGTH	THETA	E KELLER	ZETA		DISTORTION FUNCTION			
-9.99999999$_{10}$+03	1.5271629	1.00000000	-0.00005	3'	1.00000596	0.00052007	0	0
-9302.087	1.5271635	1.00001272	-0.00009	3'	1.00001197	0.00104503	0	0
-8604.193	1.5271646	1.00003714	-0.00018	3'	1.00002406	0.00210004	0	0
-7906.297	1.5271666	1.00008412	-0.00037	4'	1.00004834	0.00421968	0	0
-7208.442	1.5271709	1.00018211	-0.00074	4'	1.00009711	0.00847781	0	0
-6510.657	1.5271794	1.00037805	-0.00149	5'	1.00019503	0.01702893	0	0
-5813.007	1.5271965	1.00077034	-0.00299	5'	1.00039142	0.03418927	0	0
-5115.631	1.5272308	1.00155719	-0.00600	6'	1.00078458	0.06857882	0	0
-4418.803	1.5272988	1.00312467	-0.01205	6'	1.00156362	0.13730499	0	0
-3723.062	1.5274331	1.00623304	-0.02416	8'	1.00312023	0.27389827	0	0
-3029.468	1.5276932	1.01230674	-0.04834	9'	1.00614525	0.54246648	0	0
-2340.032	1.5281795	1.02386117	-0.09632	13'	1.01187584	1.05975172	0	0
-1658.369	1.5290329	1.04478995	-0.19045	20'	1.02217398	2.01928097	0	0
-990.349	1.5303801	1.07962646	-0.37145	31'	1.03908909	3.68972835	0	0
-343.866	1.5322009	1.13057140	-0.70902	80'	1.06333954	0.05383011	0	0
273.507	1.5342357	1.19350992	-0.76071	205'	1.08572172	5.11311366		
858.347	1.5361204	1.25839277	-0.42336	55'	1.12187760	1.87025034		
1413.051	1.5376217	1.31535254	-0.24340	30'	1.14701326	6.03660925		
1943.747	1.5387015	1.35961566	-0.14317	21'	1.16616393	4.69664252		
2457.175	1.5394312	1.39124891	-0.08568	16'	1.17965804	3.86192783		
2958.936	1.5399064	1.41265751	-0.05147	12'	1.18870344	3.34521019		
3453.096	1.5402095	1.42665815	-0.03165	9'	1.19458112	3.02399152		
3942.408	1.5404004	1.43561796	-0.01940	9'	1.19832777	2.82886783		
4428.668	1.5405197	1.44127664	-0.01193	6'	1.20068790	2.70713007		
4913.020	1.5405940	1.44482252	-0.00735	6'	1.20216380	2.63193393		
5396.184	1.5406401	1.44702212	-0.00453	6'	1.20308261	2.58547820		
5878.610	1.5406687	1.44840380	-0.00280	6'	1.20365301	2.55677445		
6360.580	1.5406864	1.44925495	-0.00173	5'	1.20400651	2.53903759		
6842.257	1.5406973	1.44978238	-0.00107	5'	1.20422535	2.52807686		
7323.779	1.5407041	1.45010746	-0.00066	4'	1.20436075	2.52130328		
7805.182	1.5407083	1.45031038	-0.00041	4'	1.20444443	2.51711720		
8286.518	1.5407108	1.45043287	-0.00025	4'	1.20449625	2.51453017		
8767.814	1.5407124	1.45051047	-0.00016	3'	1.20452826	2.51293135		
9249.084	1.5407134	1.45055826	-0.00010	3'	1.20454803	2.51194324		
9730.338	1.5407140	1.45058808	-0.00006	3'	1.20456026	2.51133258		
1.02115822$_{10}$+04	1.5407144	1.45060605	-0.00004	3'	1.20456782	2.51095517		

OMEGA 3.00000000,+09 KAPPA 0.0100 DELTA 0.001000 VECTORLENGTH 1.60
ALPHA -13.56511 BETA -73.71853 GAMMA -87.28364
REFLECTIONFACTOR 0 1.5959427 TRANSITFACTOR 1.2045800 2.5103445

HEIGTH	THETA	E KELLER	ZETA		DISTORTION FUNCTION			
-1000.000	1.5271629	1.00000000	-0.00005	3'	1.00000596	0.00052007	0	0
-930.209	1.5271635	1.00001272	-0.00009	3'	1.00001197	0.00104508	0	0
-860.418	1.5271646	1.00003714	-0.00018	3'	1.00002406	0.00210004	0	0
-790.630	1.5271666	1.00008412	-0.00037	4'	1.00004834	0.00421968	0	0
-720.844	1.5271709	1.00018211	-0.00074	4'	1.00009711	0.00847781	0	0
-651.066	1.5271794	1.00037805	-0.00149	5'	1.00019503	0.01702893	0	0
-581.301	1.5271965	1.00077034	-0.00299	5'	1.00039142	0.03413928	0	0
-511.563	1.5272308	1.00155719	-0.00600	6'	1.00078458	0.06857882	0	0
-441.880	1.5272988	1.00312467	-0.01205	6'	1.00156862	0.13730499	0	0
-372.306	1.5274331	1.00623304	-0.02416	8'	1.00312023	0.27389827	0	0
-302.947	1.5276932	1.01230674	-0.04834	9'	1.00614525	0.54216648	0	0
-234.003	1.5281795	1.02386117	-0.09632	13'	1.01187589	1.05975173	0	0
-165.837	1.5290329	1.04478995	-0.19045	20'	1.02217397	2.01928099	0	0
-99.035	1.5303801	1.07962646	-0.37145	31'	1.03908910	3.68972839	0	0
-34.387	1.5322009	1.13057140	-0.70902	80'	1.06333781	0.05383300	0	0
27.351	1.5312357	1.19350992	-0.76071	205'	1.09709971	5.10574557		
85.835	1.5361204	1.25839277	-0.42386	55'	1.12188805	1.87025083		
141.305	1.5376217	1.31535254	-0.24360	30'	1.14701322	6.03660917		
194.375	1.5387015	1.35961566	-0.14317	21'	1.16616382	4.69661247		
245.718	1.5394312	1.39124891	-0.08568	16'	1.17965804	3.86192781		
295.894	1.5399064	1.41265751	-0.05187	12'	1.18870344	3.34521016		
345.310	1.5402095	1.42665815	-0.03165	9'	1.19458112	3.02599151		
394.241	1.5404004	1.43561796	-0.01940	9'	1.19832777	2.82886787		
442.867	1.5405197	1.44127664	-0.01193	6'	1.20068789	2.70713007		
491.302	1.5405940	1.44482252	-0.00735	6'	1.20216380	2.63193393		
539.618	1.5406401	1.44703212	-0.00453	6'	1.20308261	2.58547820		
587.861	1.5406687	1.44840380	-0.00280	6'	1.20365301	2.55677445		
636.058	1.5406864	1.44925195	-0.00173	5'	1.20400651	2.53903759		
684.227	1.5406973	1.44978238	-0.00107	5'	1.20422535	2.52807686		
732.378	1.5407041	1.45010746	-0.00066	4'	1.20436075	2.52130328		
780.518	1.5407083	1.45031038	-0.00041	4'	1.20444448	2.51711720		
828.652	1.5407108	1.45043287	-0.00025	4'	1.20449625	2.51453017		
876.781	1.5407124	1.45051047	-0.00016	3'	1.20452826	2.51293135		
924.908	1.5407134	1.45055826	-0.00010	3'	1.20454803	2.51194324		
973.034	1.5407140	1.45058808	-0.00006	3'	1.20456026	2.51133258		
1021.158	1.5407144	1.45060605	-0.00004	3'	1.20456782	2.51095517		

OMEGA 3.00000000₁₀+10 KAPPA 0.1000 DELTA 0.001000 VECTORLENGTH 1.60
ALPHA -13.56511 BETA -73.71853 GAMMA -87.28364
REFLECTIONFACTOR 0 1.5959427 TRANSITFACTOR 1.2045800 2.5103445

HEIGTH	THETA	E KELLER	ZETA		DISTORTION FUNCTION			
-100.000	1.5271629	1.00000000	-0.00005	3'	1.00000596	0.00052007	0	0
-93.021	1.5271635	1.00001272	-0.00009	3'	1.00001197	0.00104508	0	0
-86.042	1.5271646	1.00003714	-0.00018	3'	1.00002406	0.00210004	0	0
-79.063	1.5271666	1.00008412	-0.00037	4'	1.00004834	0.00421968	0	0
-72.084	1.5271709	1.00018211	-0.00074	4'	1.00009711	0.00847781	0	0
-65.107	1.5271794	1.00037805	-0.00149	5'	1.00019503	0.01702893	0	0
-58.130	1.5271965	1.00077034	-0.00299	5'	1.00039142	0.03418928	0	0
-51.156	1.5272308	1.00155719	-0.00600	6'	1.00078458	0.06857882	0	0
-44.188	1.5272983	1.00312467	-0.01205	6'	1.00156861	0.13730500	0	0
-37.231	1.5274331	1.00623304	-0.02416	8'	1.00312023	0.27389828	0	0
-30.295	1.5276932	1.01230674	-0.04834	9'	1.00614525	0.54246650	0	0
-23.400	1.5281795	1.02386117	-0.09632	13'	1.01187584	1.05975176	0	0
-16.584	1.5290329	1.04478995	-0.19045	20'	1.02217398	2.01928107	0	0
-9.903	1.5303801	1.07962646	-0.37145	31'	1.03908905	3.68972850	0	0
-3.439	1.5322009	1.13057140	-0.70902	80'	1.06334058	0.05383086	0	0
2.735	1.5342357	1.19350992	-0.76071	205'	1.08903726	5.11731622		
8.583	1.5361204	1.25839277	-0.42386	55'	1.12188805	1.87025040		
14.131	1.5376217	1.31535254	-0.24340	30'	1.14701327	6.03660908		
19.437	1.5387015	1.35961566	-0.14317	21'	1.16616382	4.69664241		
24.572	1.5394312	1.39124891	-0.08568	16'	1.17965804	3.86192776		
29.589	1.5399064	1.41265751	-0.05187	12'	1.18870344	3.34521013		
34.531	1.5402095	1.42665815	-0.03165	9'	1.19458112	3.02599149		
39.424	1.5404004	1.43561796	-0.01940	9'	1.19832776	2.82886786		
7,/43.22 [illegible]	[illegible]	[illegible]	-0.01193					
49.130	1.5405940	1.44482252	-0.00735					
-88-	1.20216380	2.63193392						
53.962	1.5406401	1.44703212	-0.00453	6'	1.20308261	2.58547820		
58.786	1.5406687	1.44940380	-0.00280	6'	1.20365301	2.55677445		
63.606	1.5406864	1.44925495	-0.00173	5'	1.20400651	2.53903759		
68.423	1.5406973	1.44978238	-0.00107	5'	1.20422535	2.52807686		
73.238	1.5407041	1.45010746	-0.00066	4'	1.20436075	2.52130328		
78.052	1.5407083	1.45031038	-0.00041	4'	1.20444448	2.51711720		
82.865	1.5407108	1.45043287	-0.00025	4'	1.20449625	2.51453017		
87.678	1.5407124	1.45051047	-0.00016	3'	1.20452826	2.51293135		
92.491	1.5407134	1.45055826	-0.00010	3'	1.20454803	2.51194324		
97.303	1.5407140	1.45058808	-0.00006	3'	1.20456026	2.51133258		
102.116	1.5407144	1.45060605	-0.00004	3'	1.20456782	2.51095517		

OMEGA 3.00000000$_{10}$+11 KAPPA 1.0000 DELTA 0.001000 VECTORLENGTH 1.60
ALPHA -13.56511 BETA -73.71853 GAMMA -87.28364
REFLECTIONFACTOR 0 1.5959437 TRANSITFACTOR 1.2045806 2.5103464

HEIGTH	THETA	E KELLER	ZETA		DISTORTION FUNCTION			
-10.000	1.5271629	1.00000000	-0.00005	3'	1.00000596	0.00052007	0	0
-9.302	1.5271635	1.00001272	-0.00009	3'	1.00001197	0.00104508	0	0
-8.604	1.5271646	1.00003714	-0.00018	3'	1.00002406	0.00210004	0	0
-7.906	1.5271666	1.00008412	-0.00037	4'	1.00004834	0.00421968	0	0
-7.208	1.5271709	1.00018211	-0.00074	4'	1.00009711	0.00847781	0	0
-6.511	1.5271794	1.00037805	-0.00149	5'	1.00019503	0.01702393	0	0
-5.813	1.5271965	1.00077034	-0.00299	5'	1.00039142	0.03418927	0	0
-5.116	1.5272302	1.00155719	-0.00600	6'	1.00078458	0.06857882	0	0
-4.419	1.5272988	1.00312167	-0.01205	6'	1.00156861	0.13730499	0	0
-3.723	1.5274331	1.00623304	-0.02416	8'	1.00312023	0.27389827	0	0
-3.029	1.5276932	1.01230674	-0.04834	9'	1.00614525	0.54216650	0	0
-2.340	1.5281795	1.02386117	-0.09632	13'	1.01197584	1.05975176	0	0
-1.658	1.5290329	1.04478995	-0.19045	20'	1.02217398	2.01928107	0	0
-0.990	1.5303801	1.07962646	-0.37145	31'	1.03908908	3.68972849	0	0
-0.344	1.5322009	1.13057140	-0.70902	80'	1.06334047	0.05382548	0	0
0.274	1.5342357	1.19350992	-0.76071	205'	1.09868756	5.12556160		
0.858	1.5361204	1.25839277	-0.42336	55'	1.12188769	1.87024993		
1.413	1.5376217	1.31535254	-0.24310	30'	1.14701390	6.03661101		
1.944	1.5387015	1.35961566	-0.14317	21'	1.16616438	4.69664431		
2.457	1.5394312	1.39124891	-0.08568	16'	1.17965360	3.86192966		
2.959	1.5399064	1.41265751	-0.05187	12'	1.18870401	3.34521203		
3.453	1.5402095	1.42665815	-0.03165	9'	1.19458169	3.02599340		
3.942	1.5404004	1.43561796	-0.01910	9'	1.19832834	2.82886976		
4.429	1.5405197	1.44127664	-0.01193	6'	1.20068847	2.70713196		
4.913	1.5405940	1.44482252	-0.00735	6'	1.20216438	2.63193583		
5.396	1.5406401	1.44703212	-0.00453	+ 6'	1.20308318	2.58548011		
5.879	1.5406687	1.44840380	-0.00280	6'	1.20365359	2.55677636		
6.361	1.5406864	1.44925495	-0.00173	5'	1.20400708	2.53903950		
6.842	1.5406973	1.44978238	-0.00107	5'	1.20422593	2.52807876		
7.324	1.5407041	1.45010746	-0.00066	4'	1.20436132	2.52130519		
7.805	1.5407083	1.45031038	-0.00041	4'	1.20444506	2.51711911		
8.287	1.5407108	1.45043287	-0.00025	4'	1.20449682	2.51453208		
8.768	1.5407121	1.45051047	-0.00016	3'	1.20452883	2.51293325		
9.249	1.5407134	1.45055826	-0.00010	3'	1.20454861	2.51194515		
9.730	1.5407140	1.45058908	-0.00006	3'	1.20456084	2.51133449		
10.212	1.5407144	1.45060605	-0.00004	3'	1.20456839	2.51095708		

0	0.49876	200.49876	200.99751	0	2.634560287	1.00249027	0.001239777
0.1745329	0.50649	197.43742	197.94391	0	2.706068695	1.00256868	0.001289368
0.3490658	0.53094	188.34494	188.87588	0	2.930000961	1.00282304	0.001491547
0.5235988	0.57639	173.49257	174.06896	0	3.337729156	1.00332621	0.001911163
0.6981317	0.65223	153.32083	153.97305	0	3.994522750	1.00426244	0.002773285
0.8726646	0.77869	128.42006	129.19875	0	5.029771507	1.00608284	0.004718781
1.0471976	1.00509	99.49374	100.49882	0	0.431661269	1.01015443	0.010154724
1.1344640	1.19401	83.75130	84.94531	0	1.703584075	1.01436052	0.017021179
1.2217305	1.48680	67.25851	68.74531	0	3.459949374	1.02235525	0.032867432
1.3089969	1.99908	50.02307	52.02215	0	6.038943172	1.04079435	0.079906464
1.3962634	3.14922	31.75388	34.90310	0	3.930568039	1.10462183	0.312789440
TOTALREFLECTION							
1.4711299	10.00000	10.00000	20.00000	1.000000000	4.188952923	11.20997906	0.523680210

OMEGA 3.0000$_{10}$+07 KAPPA 0.001 DELTA 0.10000

THETA	ALPHA	BETA	GAMMA	REFLECTIONFACTOR		TRANSITFACTOR	
0	4.88088	204.88088	209.76177	0	3.980589688	1.02411467	0.116294861
0.1745329	4.95995	201.61508	206.57503	0	4.415957272	1.02490999	0.122035980
0.3490658	5.21103	191.90061	197.11164	0	5.766875088	1.02753286	0.141525269
0.5235988	5.68257	175.97657	181.65915	0	1.897357464	1.03283026	0.183521271
0.6981317	6.48500	154.20208	160.68707	0	5.669017315	1.04297684	0.272808075
0.8726646	7.87675	126.95591	134.83266	0	5.069301784	1.06409354	0.488992691
1.0471976	10.60736	94.27418	104.88153	0	1.184393466	1.11962436	1.196004868
1.1344640	13.26529	75.38471	88.65000	0	1.019963503	1.19460710	2.346395493
1.2217305	18.93689	52.80698	71.74387	0	2.712900579	1.45540428	0.660828292
TOTALREFLECTION							
1.2645255	31.62278	31.62278	63.24555	1.000000000	1.291061997	19.93450010	5.357919335

OMEGA 3.0000$_{10}$+07 KAPPA 0.010 DELTA 0.00001

OMEGA 3,0000$_{10}$+07 KAPPA 0,01 DELTA 0,00001

THETA	ALPHA	BETA	GAMMA	REFLECTIONFACTOR		TRANSITFACTOR	
0	0,00005	20,00005	20,00010	0	3,141950369	1,00000262	0,000000238
0,1745329	0,00005	19,69620	19,69625	0	3,141954422	1,00000250	0
0,3490658	0,00005	18,79389	18,79395	0	3,141966343	1,00000286	6,283185065
0,5235988	0,00006	17,32054	17,32059	0	3,141988873	1,00000334	6,283185065
0,6981317	0,00007	15,32090	15,32097	0	3,142023981	1,00000417	6,283185065
0,8726646	0,00008	12,85574	12,85582	0	3,142079949	1,00000596	0,000000119
1,0471976	0,00010	9,99995	10,00005	0,000000000	3,142168820	1,00001007	0
1,1344640	0,00012	8,45229	8,45241	0,000000000	3,142234862	1,00001401	0,000000119
1,2217305	0,00015	6,84029	6,84044	0,000000000	3,142324150	1,00002140	6,283185273
1,3089969	0,00019	5,17621	5,17641	0,000000000	3,142452165	1,00003731	0
1,3962634	0,00029	3,47269	3,47298	0,000000033	3,142646119	1,00008291	0,000000015
1,4835299	0,00057	1,74255	1,74312	0,000015118	3,142925516	1,00032935	0,000000171
TOTALREFLECTION							
1,5676343	0,03162	0,03162	0,06325	1,000000000	3,141744293	2,00328501	0,000075825

OMEGA 3,0000$_{10}$+07 KAPPA 0,01 DELTA 0,00010

THETA	ALPHA	BETA	GAMMA	REFLECTIONFACTOR		TRANSITFACTOR	
0	0,00050	20,00050	20,00100	0	3,145166199	1,00002503	0,000000238
0,1745329	0,00051	19,69663	19,69714	0	3,145205021	1,00002551	6,283185065
0,3490658	0,00053	18,79426	18,79479	0	3,145328760	1,00002825	6,283185065
0,5235988	0,00058	17,32080	17,32137	0	3,145552635	1,00003326	0
0,6981317	0,00065	15,32100	15,32165	0	3,145909727	1,00004256	0,000000238
0,8726646	0,00078	12,85562	12,85640	0	3,146464467	1,00006056	0,000000119
1,0471976	0,00100	9,99950	10,00050	0,000000000	3,147354394	1,00009996	0,000000119
1,1344640	0,00118	8,45160	8,45279	0,000000000	3,148012221	1,00013996	0,000000060
1,2217305	0,00146	6,83928	6,84075	0,000000000	3,148908675	1,00021388	0,000000328
1,3089969	0,00193	5,17471	5,17664	0,000000001	3,150189623	1,00037352	0,000000715
1,3962634	0,00288	3,47026	3,47314	0,000000333	3,152132697	1,00083072	0,000002369
1,4835299	0,00576	1,73745	1,74320	0,000154088	3,154944651	1,00331811	0,000017911
TOTALREFLECTION							
1,5607968	0,10000	0,10000	0,20000	1,000000000	3,146279752	2,03242141	0,002343550

OMEGA 3,0000$_{10}$+07 KAPPA 0,01 DELTA 0,00100

THETA	ALPHA	BETA	GAMMA	REFLECTIONFACTOR		TRANSITFACTOR	
0	0,00500	20,00500	20,01000	0	3,177318811	1,00024989	0,000001192
0,1745329	0,00508	19,70092	19,70600	0	3,177714825	1,00025764	0,000000954
0,3490658	0,00532	18,79793	18,80325	0	3,178951263	1,00028304	0,000001431
0,5235988	0,00577	17,32339	17,32917	0	3,181189299	1,00033336	0,000002146
0,6981317	0,00653	15,32202	15,32855	0	3,184760213	1,00042602	0,000002742
0,8726646	0,00778	12,85440	12,86218	0,000000000	3,190318286	1,00060529	0,000004888
1,0471976	0,01001	9,99499	10,00500	0,000000000	3,199233472	1,00100144	0,000009835
1,1344640	0,01184	8,44475	8,45659	0,000000000	3,205835640	1,00140324	0,000016510
1,2217305	0,01464	6,82918	6,84382	0,000000000	3,214842856	1,00214646	0,000031352
1,3089969	0,01938	5,15959	5,17897	0,000020011	3,227759555	1,00376347	0,000072300
1,3962634	0,02902	3,44568	3,47470	0,000003633	3,247535355	1,00845872	0,000241064
1,4835299	0,05936	1,68463	1,74399	0,001886814	3,277449504	1,03587764	0,001956820
TOTALREFLECTION							
1,5391848	0,31623	0,31623	0,63246	1,000000000	3,263062499	2,28839909	0,060734928

OMEGA 3,0000$_{10}$+07 KAPPA 0,01 DELTA 0,01000

THETA	ALPHA	BETA	GAMMA	REFLECTIONFACTOR		TRANSITFACTOR	
0	0,04988	20,04988	20,09975	0	3,498292565	1,00249076	0,000123978
0,1745329	0,05065	19,74374	19,79439	0	3,502266049	1,00256843	0,000129700
0,3490658	0,05309	18,83449	18,88759	0	3,514676213	1,00282292	0,000149727
0,5235988	0,05764	17,34926	17,40690	0	3,537156940	1,00332789	0,000191450
0,6981317	0,06522	15,33208	15,39731	0	3,573098540	1,00426316	0,000277281
0,8726646	0,07787	12,84201	12,91988	0,000000000	3,629217863	1,00608212	0,000471711
1,0471976	0,10051	9,94937	10,04988	0,000000000	3,719833612	1,01015365	0,001013637
1,1344640	0,11940	8,37513	8,49453	0,000000000	3,787572056	1,01439967	0,001698196
1,2217305	0,14868	6,72585	6,87453	0,000000001	3,881185442	1,02235561	0,003274739
1,3089969	0,19991	5,00231	5,20221	0,000000201	4,018932208	1,04079460	0,007937357
1,3962634	0,31492	3,17539	3,49031	0,000107803	4,244092375	1,10462245	0,030751150
TOTALREFLECTION							
1,4711299	1,00000	1,00000	2,00000	1,000000000	4,607446223	3,55153244	0,732926801

OMEGA 3,0000$_{10}$+07 KAPPA 0,01 DELTA 0,10000

THETA	ALPHA	BETA	GAMMA	REFLECTIONFACTOR		TRANSITFACTOR	
0	0,48809	20,48809	20,97618	0	0,298200309	1,02411382	0,011624098
0,1745329	0,49999	20,15751	20,65750	0	0,335891426	1,02491121	0,012198448
0,3490658	0,52110	19,19006	19,71116	0	0,453375638	1,02753384	0,014145851
0,5235988	0,56826	17,59766	18,16591	0	0,665235579	1,03283026	0,018342733
0,6981317	0,64850	15,42021	16,06871	0	1,001053870	1,04297808	0,027261019
0,8726646	0,78768	12,69559	13,48327	0,000000000	1,517004669	1,06409315	0,048851371
1,0471976	1,06074	9,42742	10,48815	0,000000000	2,323969364	1,11962550	0,119379944
1,1344640	1,32653	7,53847	8,86500	0,000000003	2,902978778	1,19460867	0,233937711
1,2217305	1,89369	5,28070	7,17439	0,000023924	3,666269273	1,45540623	0,689747125
TOTALREFLECTION							
1,2645255	3,16228	3,16228	6,32456	1,000000000	4,134703040	6,30383876	3,638147861

OMEGA 3,0000$_{10}$+07 KAPPA 0,10 DELTA 0,00001

THETA	ALPHA	BETA	GAMMA	REFLECTIONFACTOR		TRANSITFACTOR	
0	0,00000	2,00000	2,00001	0,000000059	3,141609993	1,00000252	0,000000037
0,1745329	0,00001	1,96962	1,96963	0,000000066	3,141605586	1,00000261	6,283185259
0,3490658	0,00001	1,87939	1,87939	0,000000091	3,141605765	1,00000282	0,000000015
0,5235988	0,00001	1,73205	1,73206	0,000000157	3,141609996	1,00000326	0
0,6981317	0,00001	1,53209	1,53210	0,000000333	3,141606241	1,00000428	6,283185288
0,8726646	0,00001	1,28557	1,28558	0,000000861	3,141606390	1,00000604	0
1,0471976	0,00001	1,00000	1,00000	0,000002720	3,141606010	1,00001004	6,283185273
1,1344640	0,00001	0,84523	0,84524	0,000005250	3,141609534	1,00001399	6,283185288
1,2217305	0,00001	0,68403	0,68404	0,000010899	3,141604513	1,00002144	0
1,3089969	0,00002	0,51762	0,51764	0,000024836	3,141602814	1,00003731	0
1,3962634	0,00003	0,34727	0,34730	0,000068501	3,141600221	1,00008294	0
1,4835299	0,00006	0,17426	0,17431	0,000313437	3,141596735	1,00032931	0
TOTALREFLECTION							
1,5676343	0,00316	0,00316	0,00632	1,000000000	3,141592808	2,00003296	0,000000078

OMEGA 3,0000$_{10}$+07 KAPPA 0,10 DELTA 0,00010

THETA	ALPHA	BETA	GAMMA	REFLECTIONFACTOR		TRANSITFACTOR	
0	0,00005	2,00005	2,00010	0,000000587	3,141721845	1,00002500	0
0,1745329	0,00005	1,96966	1,96971	0,000000655	3,141722366	1,00002576	0,000000022
0,3490658	0,00005	1,87943	1,87948	0,000000912	3,141723812	1,00002830	0
0,5235988	0,00006	1,73208	1,73214	0,000001572	3,141726039	1,00003330	6,283185288
0,6981317	0,00007	1,53210	1,53217	0,000003331	3,141728587	1,00004262	0
0,8726646	0,00008	1,28556	1,28564	0,000008614	3,141730048	1,00006049	0,000000015
1,0471976	0,00010	0,99995	1,00005	0,000027209	3,141726948	1,00010003	6,283185273
1,1344640	0,00012	0,84516	0,84528	0,000052514	3,141721569	1,00014003	0
1,2217305	0,00015	0,68393	0,68407	0,000108639	3,141711354	1,00021381	0,000000015
1,3089969	0,00019	0,51747	0,51766	0,000248555	3,141694270	1,00037348	0,000000030
1,3962634	0,00029	0,34703	0,34731	0,000686149	3,141668379	1,00083050	0,000000060
1,4835299	0,00058	0,17374	0,17432	0,003153711	3,141633496	1,00331317	0,000000138
TOTALREFLECTION							
1,5607968	0,01000	0,01000	0,02000	1,000000000	3,141997457	2,00032896	0,000002403

OMEGA 3,0000$_{10}$+07 KAPPA 0,10 DELTA 0,00100

THETA	ALPHA	BETA	GAMMA	REFLECTIONFACTOR		TRANSITFACTOR	
0	0,00050	2,00050	2,00100	0,000005856	3,142884478	1,00024986	0,000000104
0,1745329	0,00051	1,97009	1,97060	0,000006543	3,142889574	1,00025766	0,000000119
0,3490658	0,00053	1,87979	1,88032	0,000009106	3,142904356	1,00028303	0,000000112
0,5235988	0,00058	1,73234	1,73292	0,000015703	3,142926991	1,00033325	0,000000183
0,6981317	0,00065	1,53220	1,53285	0,000033296	3,142952293	1,00042604	0,000000264
0,8726646	0,00078	1,28544	1,28622	0,000086187	3,142966986	1,00060538	0,000000432
1,0471976	0,00100	0,99950	1,00050	0,000272596	3,142937005	1,00100145	0,000000760
1,1344640	0,00118	0,84447	0,84566	0,000526711	3,142882630	1,00140312	0,000001192
1,2217305	0,00146	0,68292	0,68438	0,001091549	3,142780654	1,00214586	0,000001870
1,3089969	0,00194	0,51596	0,51790	0,002505666	3,142609678	1,00376027	0,000003137
1,3962634	0,00290	0,34457	0,34747	0,006977909	3,142350696	1,00843389	0,000005759
1,4835299	0,00594	0,16846	0,17440	0,033645523	3,142001569	1,03529310	0,000013605
TOTALREFLECTION							
1,5391848	0.03162	0,03162	0,06325	1,000000000	3,141744293	2,00328501	0,000075825

OMEGA 3,0000$_{10}$+07 KAPPA 0,10 DELTA 0,01000

THETA	ALPHA	BETA	GAMMA	REFLECTIONFACTOR		TRANSITFACTOR	
0	0,00499	2,00499	2,00998	0,000057614	3,154514082	1,00249070	0,000011854
0,1745329	0,00506	1,97437	1,97944	0,000064414	3,154565960	1,00256862	0,000012435
0,3490658	0,00531	1,88345	1,88876	0,000089849	3,154716820	1,00282293	0,000014208
0,5235988	0,00576	1,73493	1,74069	0,000155539	3,154948361	1,00332781	0,000017967
0,6981317	0,00652	1,53321	1,53973	0,000331715	3,155210607	1,00426302	0,000025552
0,8726646	0,00779	1,28420	1,29199	0,000866151	3,155372880	1,00608176	0,000041589
1,0471976	0,01005	0,99494	1,00499	0,002778394	3,155096903	1,01014967	0,000080399
1,1344640	0,01194	0,83751	0,84945	0,005430806	3,154566273	1,01434474	0,000120774
1,2217305	0,01487	0,67259	0,68745	0,011463665	3,153558403	1,02228842	0,000192426
1,3089969	0,01999	0,50023	0,52022	0,027286599	3,151853621	1,04040696	0,000329718
1,3962634	0,03149	0,31754	0,34903	0,084599242	3,149253510	1,10066250	0,000642080
TOTALREFLECTION							
1,4711299	0,10000	0,10000	0,20000	1,000000000	3,146279752	2,03242141	0,002343550

OMEGA 3,0000$_{10}$+07 KAPPA 0,10 DELTA 0,10000

THETA	ALPHA	BETA	GAMMA	REFLECTIONFACTOR		TRANSITFACTOR	

OMEGA 3,0000$_{10}$+07 KAPPA 0,10 DELTA 0,10000

THETA	ALPHA	BETA	GAMMA	REFLECTIONFACTOR		TRANSITFACTOR	
0	0,01881	2,01881	2,03762	0,000493212	3,270960741	1,02411357	0,001113899
0,1745329	0,01960	2,01615	2,03575	0,000555425	3,271562189	1,02491109	0,001167070
0,3490658	0,05211	1,91901	1,97112	0,000792132	3,273309473	1,02753347	0,001346599
0,5235988	0,05683	1,75977	1,81659	0,001425784	3,276173264	1,03282925	0,001727633
0,6981317	0,06485	1,54202	1,60687	0,003230132	3,279693305	1,04397253	0,002512932
0,8726646	0,07877	1,26956	1,34833	0,009267079	3,282818295	1,06404758	0,004289925
1,0471976	0,10607	0,94274	1,04882	0,035213126	3,282427669	1,11893132	0,009160966
1,1344640	0,13265	0,75385	0,88650	0,081038126	3,278994948	1,19067973	0,015172288
1,2217305	0,18937	0,52807	0,71744	0,249086997	3,269913428	1,40953369	0,029697053
TOTALREFLECTION							
1,2645255	0,31E23	0,31623	0,63246	1,000000000	3,263062499	2,28839909	0,060734928

OMEGA 3,0000$_{10}$+07 KAPPA 1,00 DELTA 0,00001

THETA	ALPHA	BETA	GAMMA	REFLECTIONFACTOR		TRANSITFACTOR	
0	0,00000	0,20000	0,20000	0,000002342	3,141592696	1,00000249	0
0,1745329	0,00000	0,19696	0,19696	0,000002420	3,141592689	1,00000260	0
0,3490658	0,00000	0,18794	0,18794	0,000002674	3,141592689	1,00000285	0
0,5235988	0,00000	0,17321	0,17321	0,000003175	3,141592681	1,00000331	0
0,6981317	0,00000	0,15321	0,15321	0,000004100	3,141592681	1,00000426	0
0,8726646	0,00000	0,12856	0,12856	0,000005809	3,141592689	1,00000604	0
1,0471976	0,00000	0,10000	0,10000	0,000009836	3,141592667	1,00000999	0
1,1344640	0,00000	0,08452	0,08452	0,000013835	3,141592667	1,00001398	0
1,2217305	0,00000	0,06840	0,06840	0,000021211	3,141592667	1,00002141	0
1,3089969	0,00000	0,05176	0,05176	0,000037159	3,141592659	1,00003733	0
1,3962634	0,00000	0,03473	0,03473	0,000082757	3,141592659	1,00008295	0
1,4835299	0,00001	0,01743	0,01743	0,000329165	3,141592644	1,00032937	0
TOTALREFLECTION							
1,5676343	0,00032	0,00032	0,00063	1,000000000	3,141592652	2,00000030	0

OMEGA 3,0000$_{10}$+07 KAPPA 1,00 DELTA 0,00010

THETA	ALPHA	BETA	GAMMA	REFLECTIONFACTOR		TRANSITFACTOR	
0	0,00001	0,20000	0,20001	0,000023427	3,141593121	1,00002499	0
0,1745329	0,00001	0,19697	0,19697	0,000024201	3,141593106	1,00002576	0
0,3490658	0,00001	0,18794	0,18795	0,000026730	3,141593091	1,00002832	0
0,5235988	0,00001	0,17321	0,17321	0,000031742	3,141593061	1,00003330	0
0,6981317	0,00001	0,15321	0,15322	0,000041001	3,141593009	1,00004263	0
0,8726646	0,00001	0,12856	0,12856	0,000058094	3,141592950	1,00006052	0
1,0471976	0,00001	0,10000	0,10001	0,000098365	3,141592690	1,00010002	0
1,1344640	0,00001	0,08452	0,08453	0,000138365	3,141592853	1,00014000	0
1,2217305	0,00001	0,06839	0,06841	0,000212150	3,141592816	1,00021379	0
1,3089969	0,00002	0,05175	0,05177	0,000371808	3,141592771	1,00037342	0
1,3962634	0,00003	0,03470	0,03473	0,000828738	3,141592734	1,00083035	0
1,4835299	0,00006	0,01737	0,01743	0,003311015	3,141592689	1,00331267	0
TOTALREFLECTION							
1,5607968	0,00100	0,00100	0,00200	1,000000000	3,141592659	2,00000328	0

OMEGA 3,0000$_{10}$+07 KAPPA 1,00 DELTA 0,00100

THETA	ALPHA	BETA	GAMMA	REFLECTIONFACTOR		TRANSITFACTOR	
0	0,00005	0,20005	0,20010	0,000234152	3,141597301	1,00024986	0
0,1745329	0,00005	0,19701	0,19706	0,000241905	3,141597234	1,00025764	0
0,3490658	0,00005	0,18798	0,18803	0,000267192	3,141597040	1,00028301	0
0,5235988	0,00006	0,17323	0,17329	0,000317324	3,141596712	1,00033326	0
0,6981317	0,00007	0,15322	0,15329	0,000409945	3,141596265	1,00042998	0
0,8726646	0,00008	0,12854	0,12862	0,000589056	3,141595706	1,00060518	0
1,0471976	0,00010	0,09995	0,10005	0,000984739	3,141595028	1,00100102	0
1,1344640	0,00012	0,08445	0,08457	0,001385939	3,141594671	1,00140231	0
1,2217305	0,00015	0,06829	0,06844	0,002127826	3,141594291	1,00214425	0
1,3089969	0,00019	0,05160	0,05179	0,003739984	3,141593888	1,00375644	0
1,3962634	0,00029	0,03446	0,03475	0,008406248	3,141593486	1,00842280	0
1,4835299	0,00059	0,01685	0,01744	0,035219869	3,141593076	1,03523694	0,000000015
TOTALREFLECTION							
1,5391848	0,00316	0,00316	0,00632	1,000000000	3,141592808	2,00003296	0,000000078

OMEGA 3,0000$_{10}$+07 KAPPA 1,00 DELTA 0,01000

THETA	ALPHA	BETA	GAMMA	REFLECTIONFACTOR		TRANSITFACTOR	
0	0,00050	0,20050	0,20100	0,002330393	3,141639352	1,00248794	0,000000112
0,1745329	0,00051	0,19744	0,19794	0,002407921	3,141638696	1,00256572	0,000000112
0,3490658	0,00053	0,18834	0,18888	0,002660968	3,141636714	1,00281941	0,000000127
0,5235988	0,00058	0,17349	0,17407	0,003163332	3,141633429	1,00332283	0,000000123
0,6981317	0,00065	0,15332	0,15397	0,004093899	3,141628936	1,00425470	0,000000160
0,8726646	0,00078	0,12842	0,12920	0,005902234	3,141623273	1,00606459	0,000000186
1,0471976	0,00101	0,09949	0,10050	0,009939406	3,141616605	1,01010371	0,000000238
1,1344640	0,00119	0,08375	0,08495	0,014093490	3,141612940	1,01425897	0,000000287
1,2217305	0,00149	0,06726	0,06875	0,021942198	3,141609110	1,02210942	0,000000354
1,3089969	0,00200	0,05002	0,05202	0,039799356	3,141605131	1,03996992	0,000000488
1,3962634	0,00315	0,03175	0,03490	0,099013298	3,141601034	1,09919392	0,000000756
TOTALREFLECTION							
1,4711299	0,01000	0,01000	0,02000	1,000000000	3,141597457	2,00032896	0,000002403

OMEGA 3,0000$_{10}$+07 KAPPA 1,00 DELTA 0,10000

THETA	ALPHA	BETA	GAMMA	REFLECTIONFACTOR		TRANSITFACTOR	
0	0,00488	0,20488	0,20976	0,022295149	3,142078966	1,02306004	0,000010934
0,1745329	0,00496	0,20162	0,20658	0,023030930	3,142072111	1,02463942	0,000011139
0,3490658	0,00521	0,19190	0,19711	0,025578228	3,142051592	1,02719761	0,000011776
0,5235988	0,00568	0,17598	0,18166	0,030705175	3,142017670	1,03234324	0,000012968
0,6981317	0,00648	0,15420	0,16069	0,040457005	3,141970865	1,04212399	0,000014976
0,8726646	0,00788	0,12696	0,13483	0,060434453	3,141912058	1,06214829	0,000018422
1,0471976	0,01061	0,09427	0,10488	0,110908332	3,141842626	1,11271839	0,000025116
1,1344640	0,01327	0,07538	0,08865	0,174384173	3,141804501	1,17630464	0,000031564
1,2217305	0,01894	0,05281	0,07174	0,357176794	3,141764492	1,35940301	0,000045285
TOTALREFLECTION							
1,2645295	0,03162	0,03162	0,06325	1,000000000	3,141744293	2,00320501	0,000075825

OMEGA 3,0000,+07 KAPPA 10,00 DELTA 0,00001

THETA	ALPHA	BETA	GAMMA	REFLECTIONFACTOR		TRANSITFACTOR	
0	0,00000	0,02000	0,02000	0,000002498	3,141592644	1,00000248	0
0,1745329	0,00000	0,01970	0,01970	0,000002577	3,141592652	1,00000256	0
0,3490658	0,00000	0,01879	0,01879	0,000002831	3,141592652	1,00000282	0
0,5235988	0,00000	0,01732	0,01732	0,000003332	3,141592644	1,00000334	0
0,6981317	0,00000	0,01532	0,01532	0,000004298	3,141592652	1,00000426	0
0,8726646	0,00000	0,01286	0,01286	0,000006049	3,141592644	1,00000605	0
1,0471976	0,00000	0,01000	0,01000	0,000009997	3,141592652	1,00000998	0
1,1344640	0,00000	0,00845	0,00845	0,000013995	3,141592659	1,00001401	0
1,2217305	0,00000	0,00684	0,00684	0,000021372	3,141592652	1,00002138	0
1,3089969	0,00000	0,00518	0,00518	0,000037321	3,141592652	1,00003731	0
1,3962634	0,00000	0,00347	0,00347	0,000082920	3,141592659	1,00008292	0
1,4835299	0,00000	0,00174	0,00174	0,000329327	3,141592644	1,00032932	0
TOTALREFLECTION							
1,5676343	0,00003	0,00003	0,00006	1,000000000	3,141592652	2,00000000	0

OMEGA

OMEGA 3,0000$_{10}$+07 KAPPA 10,00 DELTA 0,0001

THETA	ALPHA	BETA	GAMMA	REFLECTIONFACTOR		TRANSITFACTOR	
0	0,00000	0,02000	0,02000	0,000002498	3,141592644	1,00000248	0
0,1745329	0,00000	0,01970	0,01970	0,000002577	3,141592652	1,00000256	0
0,3490658	0,00000	0,01879	0,01879	0,000002831	3,141592652	1,00000282	0
0,5235988	0,00000	0,01732	0,01732	0,000003332	3,141592644	1,00000334	0
0,6981317	0,00000	0,01532	0,01532	0,000004258	3,141592652	1,00000426	0
0,8726646	0,00000	0,01286	0,01286	0,000006049	3,141592644	1,00000605	0
1,0471976	0,00000	0,01000	0,01000	0,000009997	3,141592652	1,00000998	0
1,1344640	0,00000	0,00845	0,00845	0,000013995	3,141592659	1,00001401	0
1,2217305	0,00000	0,00684	0,00684	0,000021372	3,141592652	1,00002138	0
1,3089969	0,00000	0,00518	0,00518	0,000037321	3,141592652	1,00003731	0
1,3962634	0,00000	0,00347	0,00347	0,000082920	3,141592659	1,00008292	0
1,4835299	0,00000	0,00174	0,00174	0,000329327	3,141592644	1,00032932	0
TOTALREFLECTION							
1,5676343	0,00003	0,00003	0,00006	1,000000000	3,141592652	2,00000000	0

OMEGA 3,0000$_{10}$+07 KAPPA 10,00 DELTA 0,00010

THETA	ALPHA	BETA	GAMMA	REFLECTIONFACTOR		TRANSITFACTOR	
0	0,00000	0,02000	0,02000	0,000024983	3,141592644	1,00002497	0
0,1745329	0,00000	0,01970	0,01970	0,000025760	3,141592644	1,00002575	0
0,3490658	0,00000	0,01879	0,01879	0,000028293	3,141592644	1,00002829	0
0,5235988	0,00000	0,01732	0,01732	0,000033315	3,141592644	1,00003338	0
0,6981317	0,00000	0,01532	0,01532	0,000042585	3,141592644	1,00004299	0
0,8726646	0,00000	0,01286	0,01286	0,000060492	3,141592659	1,00006048	0
1,0471976	0,00000	0,01000	0,01000	0,000099995	3,141592637	1,00010001	0
1,1344640	0,00000	0,00845	0,00845	0,000139981	3,141592652	1,00013999	0
1,2217305	0,00000	0,00684	0,00684	0,000213771	3,141592644	1,00021378	0
1,3089969	0,00000	0,00517	0,00518	0,000373432	3,141592652	1,00037346	0
1,3962634	0,00000	0,00347	0,00347	0,000830364	3,141592644	1,00083038	0
1,4835299	0,00001	0,00174	0,00174	0,003312642	3,141592644	1,00331264	0
TOTALREFLECTION							
1,5607968	0,00010	0,00010	0,00020	1,000000000	3,141592652	2,00000000	0

OMEGA 3,0000$_{10}$+07 KAPPA 10,00 DELTA 0,00100

THETA	ALPHA	BETA	GAMMA	REFLECTIONFACTOR		TRANSITFACTOR	
0	0,00000	0,02000	0,02001	0,000249708	3,141592652	1,00024986	0
0,1745329	0,00001	0,01970	0,01971	0,000257483	3,141592652	1,00025765	0
0,3490658	0,00001	0,01880	0,01880	0,000282830	3,141592652	1,00028303	0
0,5235988	0,00001	0,01732	0,01733	0,000333058	3,141592659	1,00033320	0
0,6981317	0,00001	0,01532	0,01533	0,000425795	3,141592644	1,00042592	0
0,8726646	0,00001	0,01285	0,01286	0,000605033	3,141592644	1,00060523	0
1,0471976	0,00001	0,00999	0,01000	0,001000838	3,141592652	1,00100099	0
1,1344640	0,00001	0,00844	0,00846	0,001402089	3,141592659	1,00140224	0
1,2217305	0,00001	0,00683	0,00684	0,002144022	3,141592644	1,00214419	0
1,3089969	0,00002	0,00516	0,00518	0,003756218	3,141592652	1,00375638	0
1,3962634	0,00003	0,00345	0,00347	0,008422511	3,141592644	1,00842270	0
1,4835299	0,00006	0,00168	0,00174	0,035236130	3,141592644	1,03523628	0
TOTALREFLECTION							
1,5391848	0,00032	0,00032	0,00063	1,000000000	3,141592652	2,00000000	0

OMEGA 3,0000$_{10}$+07 KAPPA 10,00 DELTA 0,01000

THETA	ALPHA	BETA	GAMMA	REFLECTIONFACTOR		TRANSITFACTOR	
0	0,00005	0,02005	0,02010	0,002489933	3,141592704	1,00248760	0
0,1745329	0,00005	0,01974	0,01979	0,002563673	3,141592689	1,00256531	0
0,3490658	0,00005	0,01883	0,01889	0,002817336	3,141592704	1,00281902	0
0,5235988	0,00006	0,01735	0,01741	0,003320650	3,141592689	1,00332227	0
0,6981317	0,00007	0,01533	0,01540	0,004252358	3,141592689	1,00425397	0
0,8726646	0,00008	0,01284	0,01292	0,006062007	3,141592674	1,00606365	0
1,0471976	0,00010	0,00995	0,01005	0,010100381	3,141592674	1,01010207	0
1,1344640	0,00012	0,00836	0,00849	0,014254988	3,141592674	1,01425668	0
1,2217305	0,00015	0,00673	0,00687	0,022104114	3,141592667	1,02210578	0
1,3089969	0,00020	0,00500	0,00520	0,039961472	3,141592659	1,03996323	0
1,3962634	0,00031	0,00318	0,00349	0,099174321	3,141592667	1,09917621	0
TOTALREFLECTION							
1,4711299	0,00100	0,00100	0,00200	1,000000000	3,141592659	2,00000328	0

OMEGA 3,0000$_{10}$+07 KAPPA 10,00 DELTA 0,10000

THETA	ALPHA	BETA	GAMMA	REFLECTIONFACTOR		TRANSITFACTOR	
0	0,00049	0,02049	0,02098	0,023806603	3,141593151	1,02382346	0,000000015
0,1745329	0,00050	0,02016	0,02066	0,024584633	3,141593136	1,02460149	0
0,3490658	0,00052	0,01919	0,01971	0,027138415	3,141593121	1,02715530	0
0,5235988	0,00057	0,01760	0,01817	0,032275227	3,141593084	1,03229221	0
0,6981317	0,00065	0,01542	0,01607	0,042038770	3,141593046	1,04205586	0,000000019
0,8726646	0,00079	0,01270	0,01348	0,062026808	3,141592972	1,06204432	0,000000019
1,0471976	0,00106	0,00943	0,01049	0,112499825	3,141592897	1,11251815	0,000000026
1,1344640	0,00133	0,00754	0,00886	0,179951992	3,141592868	1,17997130	0,000000030
1,2217305	0,00189	0,00528	0,00717	0,358591537	3,141592816	1,35861383	0,000000041
TOTALREFLECTION							
1,2645255	0,00316	0,00316	0,00632	1,000000000	3,141592808	2,00003296	0,000000078

OMEGA 3,0000$_{10}$+08 KAPPA 0,10 DELTA 0,0001

THETA	ALPHA	BETA	GAMMA	REFLECTIONFACTOR		TRANSITFACTOR	
0	0,00005	20,00005	20,00010	0	3,141950369	1,00000262	0,000000238
0,1745329	0,00005	19,69620	19,69625	0	3,141954422	1,00000250	0
0,3490658	0,00005	18,[illegible]389	18,79395	0	3,141966343	1,00000286	6,283185065
0,5235988	0,00006	17,32054	17,32059	0	3,141988873	1,00000334	6,283185065
0,6981317	0,00007	15,32090	15,32097	0	3,142023981	1,00000417	6,283185065
0,8726646	0,00008	12,85574	12,85582	0	3,142079949	1,00000596	0,000000119
1,0471976	0,00010	9,99995	10,00005	0,000000000	3,142168820	1,00001007	0
1,1344640	0,00012	8,45229	8,45241	0,000000000	3,142234862	1,00001401	0,000000119
1,2217305	0,00015	6,84029	6,84044	0,000000000	3,142234150	1,00002140	6,283185273
1,3089969	0,00019	5,17621	5,17641	0,000000000	3,142452165	1,00003731	0
1,3962634	0,00029	3,47269	3,47298	0,000000033	3,142646119	1,00008291	0,000000015
1,4835299	0,00057	1,74255	1,74312	0,000015118	3,142925516	1,00032935	0,000000171
TOTALREFLECTION							
1,5676343	0,03162	0,03162	0,06325	1,000000000	3,141744293	2,00328501	0,000075825

OMEGA 3,0000$_{10}$+08 KAPPA 0,10 DELTA 0,0010

THETA	ALPHA	BETA	GAMMA	REFLECTIONFACTOR		TRANSITFACTOR	
0	0,00050	20,00050	20,00100	0	3,145166199	1,00002503	0,000000238
0,1745329	0,00051	19,69663	19,69714	0	3,145205021	1,00002551	6,283185065
0,3490658	0,00053	18,79426	18,79479	0	3,145328760	1,00002825	6,283185065
0,5235988	0,00058	17,32080	17,32137	0	3,145552635	1,00003326	0
0,6981317	0,00065	15,32100	15,32165	0	3,145909727	1,00004256	0,000000238
0,8726646	0,00078	12,85562	12,85640	0	3,146464467	1,00006056	0,000000119
1,0471976	0,00100	9,99950	10,00050	0,000000000	3,147354394	1,00009996	0,000000119
1,1344640	0,00118	8,45160	8,45279	0,000000000	3,148012221	1,00013996	0,000000060
1,2217305	0,00146	6,83928	6,84075	0,000000000	3,148908675	1,00021388	0,000000328
1,3089969	0,00193	5,17471	5,17664	0,000000001	3,150189623	1,00037352	0,000000715
1,3962634	0,00288	3,47026	3,47314	0,000000333	3,152132697	1,00083072	0,000002369
1,4835299	0,00576	1,73745	1,74320	0,000154088	3,154944651	1,00331811	0,000017911

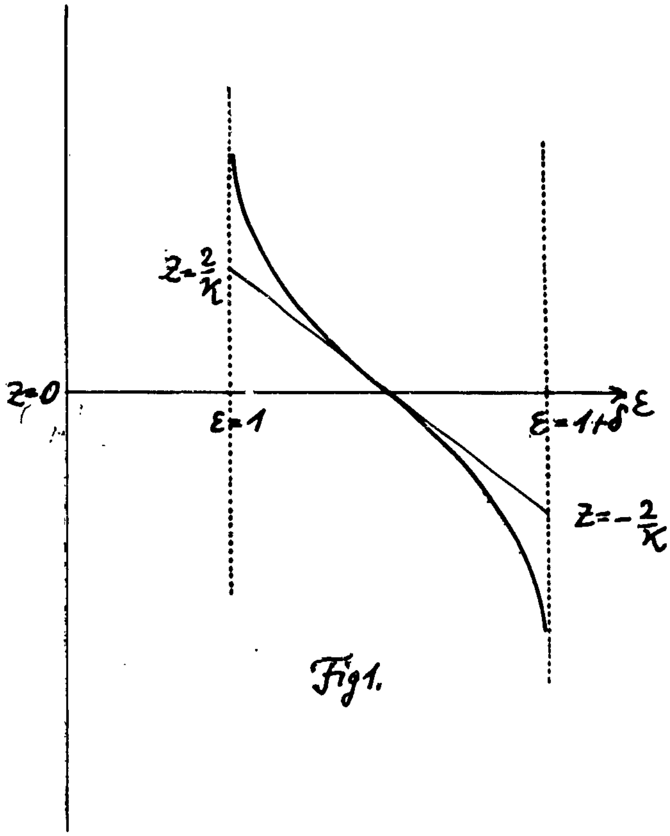

$z=\frac{2}{\kappa}$
$z=0$
$\varepsilon=1$
$\varepsilon=1+\delta$
ε
$z=-\frac{2}{\kappa}$

Fig 1.

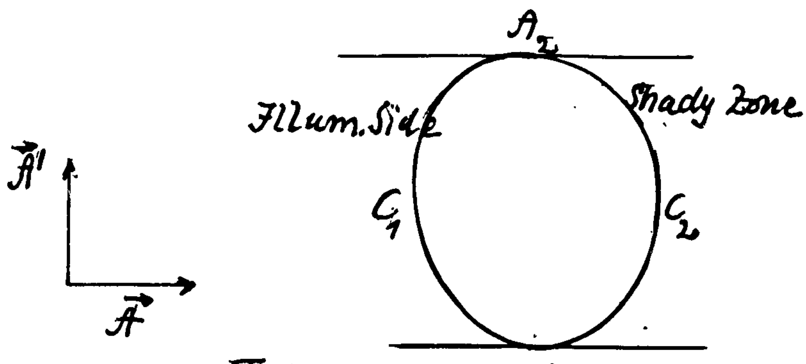

A_2
Illum. Side
Shady Zone
$\vec{A}'$
C_1
C_2
$\vec{A}$
A_1

Fig 2.

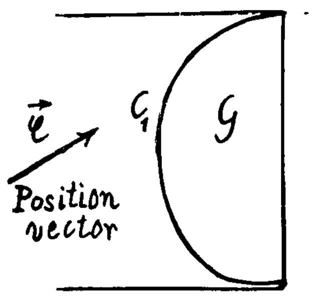


Fig 3.

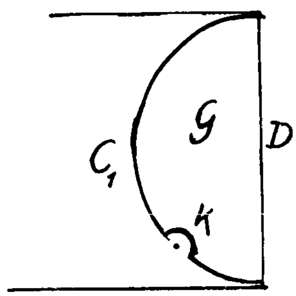


Fig. 4

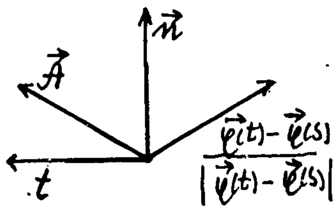


Fig 5

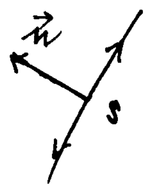


Fig 6.

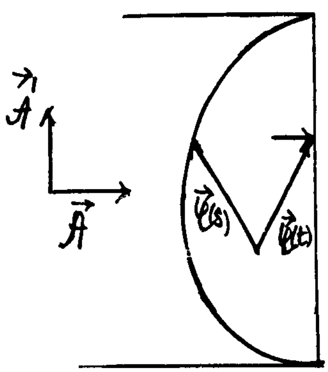


Fig 7.

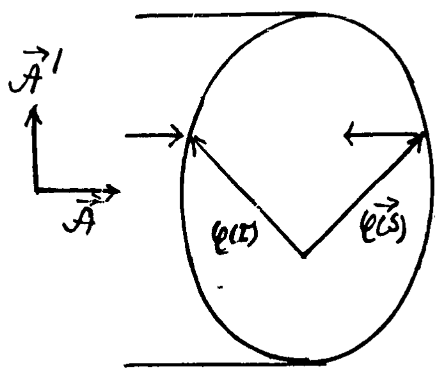


Fig. 8.

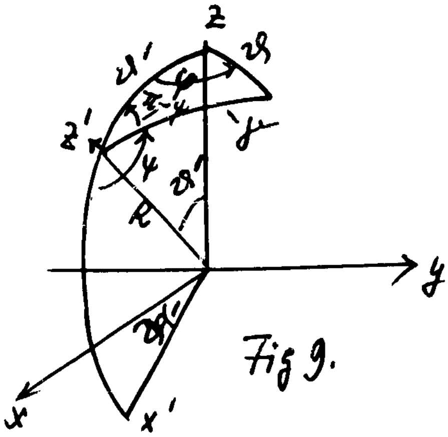


Fig 9.

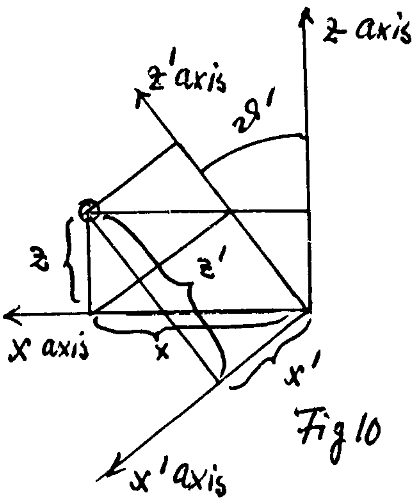


Fig 10

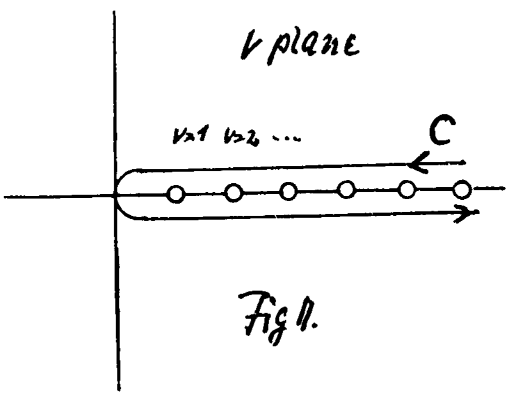


Fig 11.

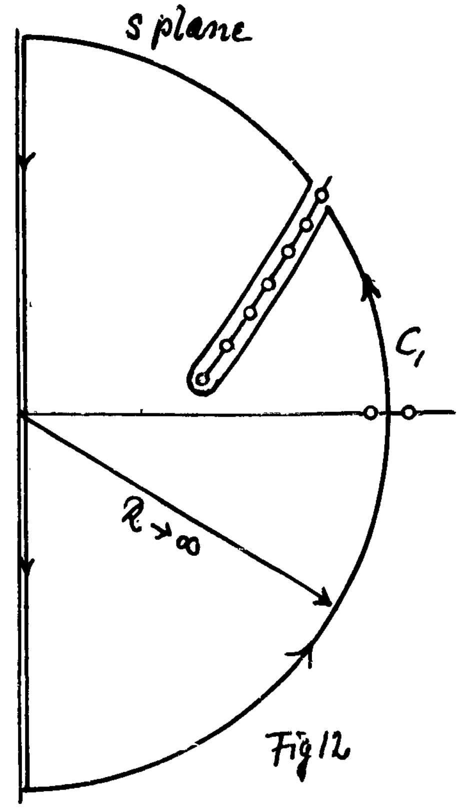


Fig 12

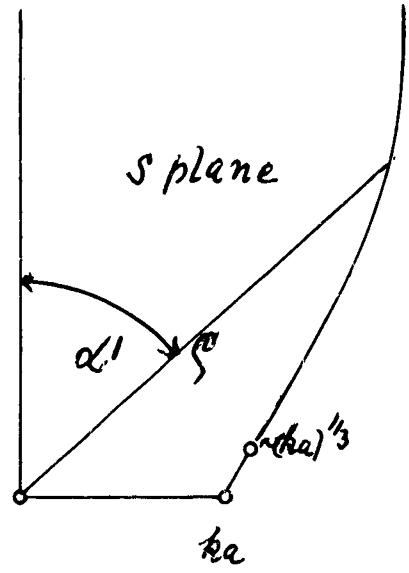


Fig. 13.

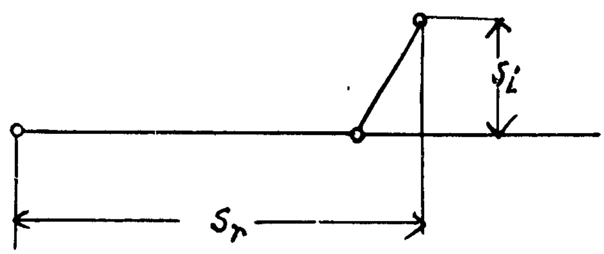
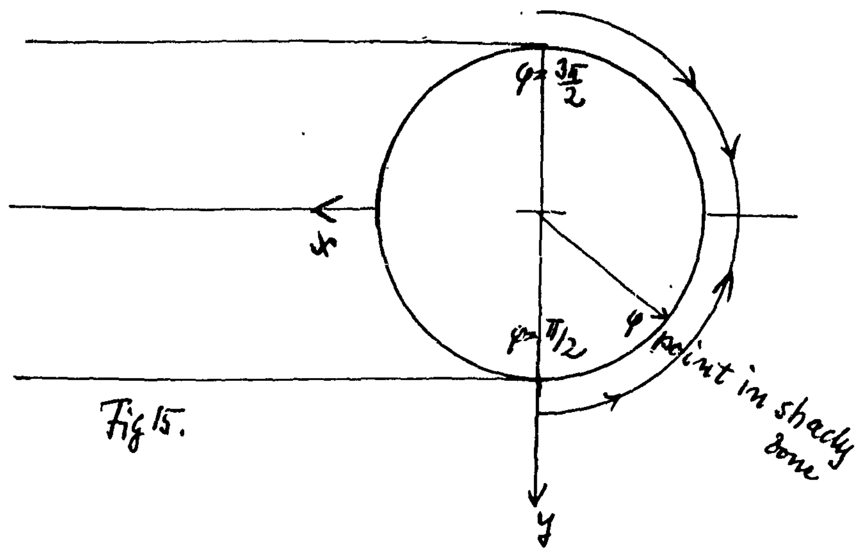
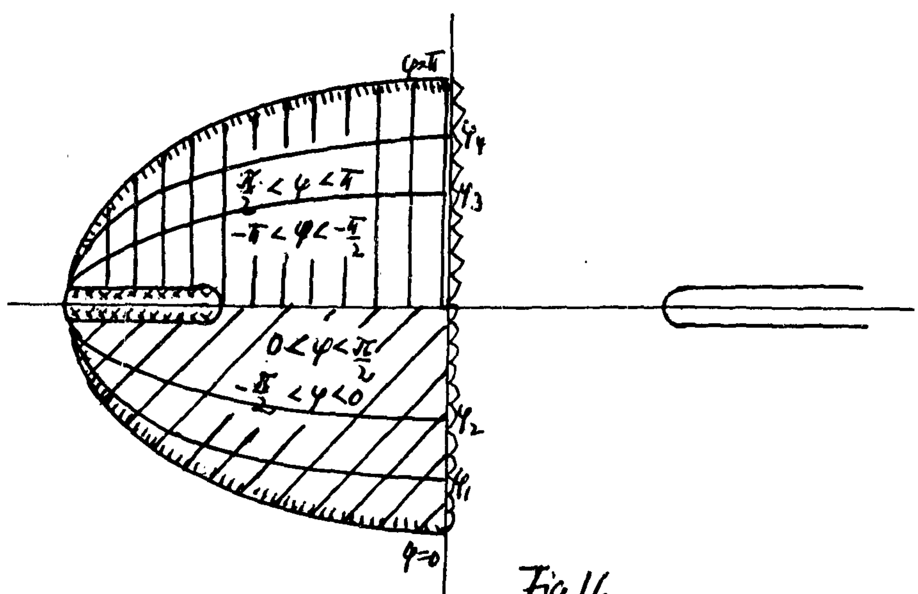


Fig 14.



$\varphi = \frac{3\pi}{2}$
x
φ
$\varphi = \pi/2$
point in shady zone
y

Fig 15.



$\varphi = \pi$
φ_4
$\frac{\pi}{2} < \varphi < \pi$
φ_3
$-\pi < \varphi < -\frac{\pi}{2}$
$0 < \varphi < \frac{\pi}{2}$
$-\frac{\pi}{2} < \varphi < 0$
φ_2
φ_1
$\varphi = 0$

Fig 16

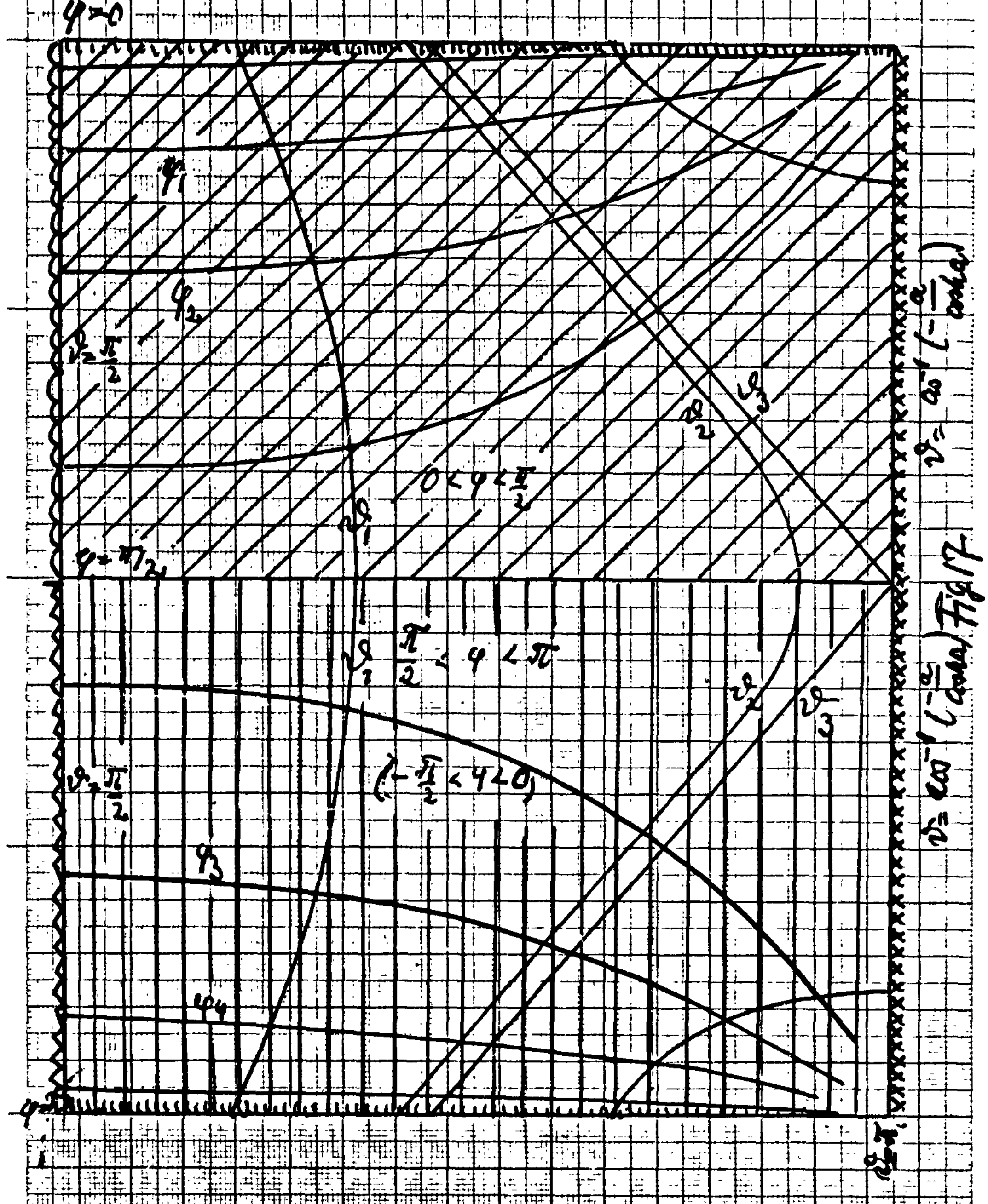


Fig 17

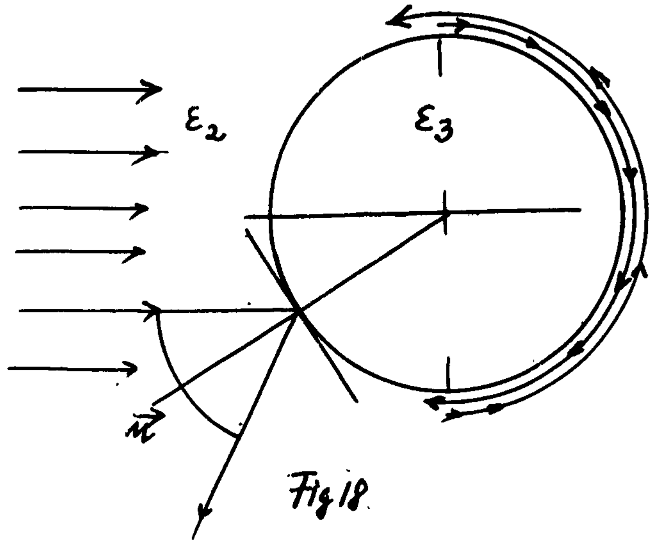


Fig 18

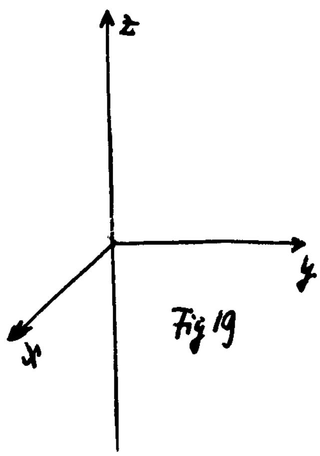


Fig 19

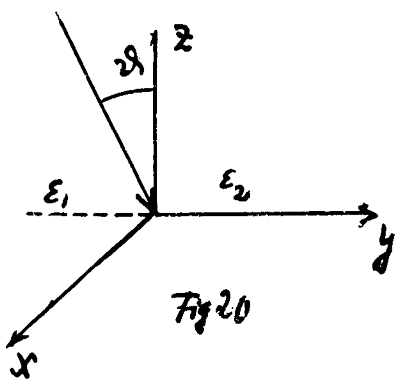


Fig 20

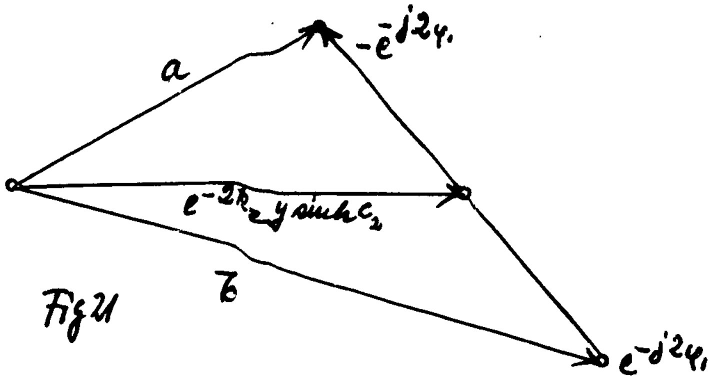


Fig 21

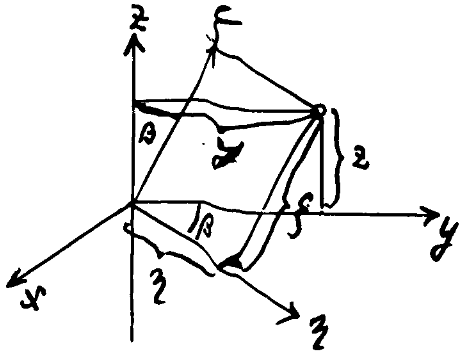


Fig 22.

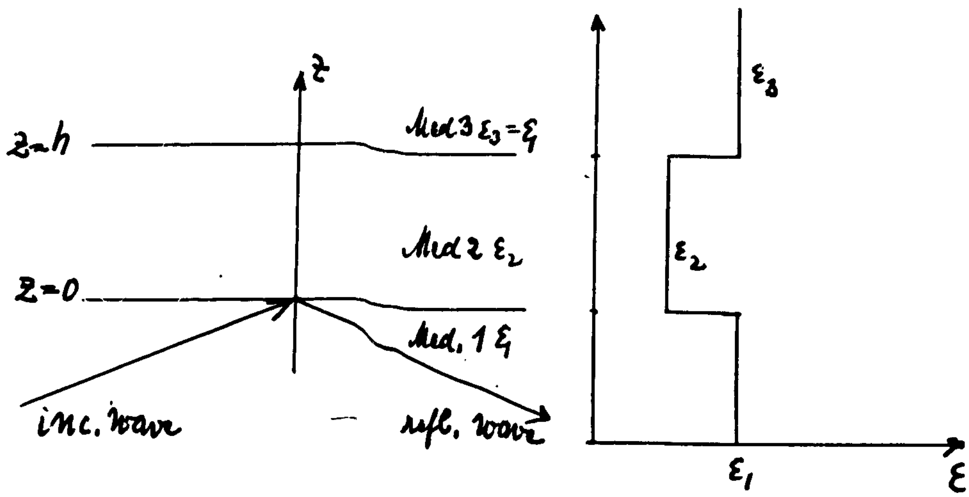


Fig 23.